Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/GB05/001158

International filing date: 23 March 2005 (23.03.2005)

Document type: Certified copy of priority document

Document details: Country/Office: GB
Number: 0406443.2
Filing date: 23 March 2004 (23.03.2004)

Date of receipt at the International Bureau: 24 May 2005 (24.05.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

PCT/GB2005/001158

The Patent Office

INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed Andrew Gersey

Dated 6 May 2005

Patents Form 1/77

Pate[redacted]977
(Rule 16)

The Patent Office

23MAR04 E883049-2 000239
P01/7700 0.00-0406443.2 CHEQUE

THE PATENT OFFICE
C
23 MAR 2004
NEWPORT

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — AS/JMP/P13453GB

2. Patent application number *(The Patent Office will fill this part in)* — 0406443.2 — 23 MAR 2004

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Ross Wark Medical Ltd
31 Birkhill Road
Cambusbarron
STIRLING
FK7 9LA
United Kingdom

Patents ADP number *(if you know it)* 8834434001

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — CAST-CUTTER

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Cruikshank & Fairweather
19 Royal Exchange Square
Glasgow
G1 3AE
United Kingdom

Patents ADP number *(if you know it)* 547002

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request? — Yes

Answer YES if:

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

Otherwise answer NO (See note d)

Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	58
Claim(s)	0
Abstract	0
Drawing(s)	40 X £40

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	
Request for a preliminary examination and search (Patents Form 9/77)	
Request for a substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) CRUIKSHANK & FAIRWEATHER Date 22 March 2004

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

Andrew Shanks
0141 221 5767

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered YES in part 8, a Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

CAST-CUTTER

The present invention relates to a cutter, and in particular, but not exclusively, to a cutter for use in removing a cast used to immobilize an injured body part from a limb or otherwise of a patient.

Typical "plaster" casts for use in immobilising limbs or other parts of the body are composed of a padded fibre layer surrounded by a plaster or fibre glass tape layer. Conventional cast-cutters remove such casts by cutting through the plaster or fibre glass layer, with the padded layer subsequently being cut using scissors, or other like instruments. This is normally repeated at opposing sides of the cast to enable the cast to be removed in two sections.

Conventional cast-cutters typically comprise an oscillating blade or disc which abrades or saws the plaster or fibre glass. As a result, large quantities of dust may be produced and dispersed within the air. In order to minimise the release of dust particles, a dust extraction device may be required, which may be cumbersome and adds additional expense to the cutting device.

Furthermore, conventional cutters are generally noisy in operation due to the action of the blade and a high speed motor, and the presence of the extraction device, which can be distressing, particularly to young patients. As a result, patients may become agitated, which makes removal of the cast without causing injury more difficult.

Additionally, in use, the blades of conventional cutters may become heated due to friction between the blade and the cast, which introduces the risk of burning the skin of the patient.

Due to the above problems, cast cutters which involve cutting the cast by a sawing action, even when operated by a skilled operator, may result in distress and injury to the patient.

It is among objects of embodiments of aspects of the present invention to obviate or at least mitigate the aforementioned and other problems with the prior art.

According to a first aspect of the present invention, there is provided a cast-cutter for use in removing a cast from a patient, the cast-cutter comprising:

a body;

cutting means supported by the body and adapted for cutting a portion of material from the cast by a shearing action; and

a protection member supported by the body and adapted to be positioned between the cutting means and the patient, to protect the skin of the patient.

Thus, in use, the protection member may be placed adjacent or against the skin of a patient with the cutting means aligned with an end portion of the cast to be removed. Once in position, the cutting means may be activated and the cast-cutter moved along the length of the cast, with the protecting member sliding under the cast, to remove material from the cast without the possibility of causing injury to the patient.

Conveniently, the shearing action of the cast-cutter allows the cutting means to cut through the entire thickness of the cast, through both rigid and padded fibre or bandage layers, for example, eliminating the requirement for scissors or the like to cut through soft material once the rigid material has been cut using conventional methods.

However, if required, the cutting means may cut through the rigid layer only, with the padded fibre layer or bandage layers being subsequently cut using conventional scissors or the like.

Preferably, the cutting means is adapted for removing a strip of material from the cast. By cutting a strip of material from a cast by a shearing action, the noise and dust problems normally associated with rotating or oscillating blades are substantially reduced, which reduces patient discomfort and anxiety. Furthermore, because the skin of the patient is protected while the device is in use, the possibility of inadvertently causing injury thereto is minimised.

Conveniently, the cast-cutter may be used in the removal of a cast from a patient by cutting a strip from alternative, and preferably opposing sides of the cast such that the cast may be removed in two portions. Alternatively, the cast-cutter may be used to cut a single strip from a cast with the cast subsequently being spread to such an extent so as to be safely removed from the patient. In this instance, the cast-cutter is particularly advantageous in that it removes a strip of cast material of a suitable width to allow a conventional spreading tool or device to be properly and readily inserted into the gap in the cast formed by the removal of the strip. It should be noted, however, that the cast-cutter may be used to cut any number of strips from the cast, as required, to allow smooth and safe removal from the patient.

In an alternative embodiment of the present invention, the cutting means is adapted for producing a single line of cut in a cast to be removed. In this way, a strip is not removed from the cast.

Preferably, the protection member is supported by the body via a connecting member which is coupled at one end to the body and at another end to the protection member. The connecting member may extend through a portion of the cutting means to be coupled between the body and protection member. For example, the connecting member may extend through an aperture or slot defined in a portion of the cutting means. Conveniently, the connecting member may be adjustable in order to vary the distance between the body and the protection member in order to accommodate casts of varying thickness, for example.

Preferably, the protection member is releasably coupled to the body, allowing individual protection members formed for a specific use to be selected and coupled to the cast-cutter as required. For example, various shapes and sizes of protection members may be used with the cast-cutter in accordance with, for example, the type, size and location of the cast to be removed.

Furthermore, providing a protection member which is releasably coupled to the body allows a previously used protection member to be removed and disposed and subsequently replaced by a new, sterile or clean protection member. In this way, the possibility of transferring infection from one patient to another is reduced. Further methods of minimising the transfer of infection between patients may involve the use of sterile covers adapted to be fitted and temporarily secured over the protection member, with a new cover being used for each patient.

Additionally, the cutting means may be completely removable to be replaced as appropriate.

The cutting means may be adapted to be secured to the body in alternate directions such that the cast-cutter may be used to cut a cast in at least two directions.

Preferably, the protection member comprises a contact surface for contacting the skin of a patient when the cast-cutter is in use. Advantageously, said contact surface may be smooth in order to reduce the friction between the contact surface and the skin of a patient, allowing smoother operation and minimising discomfort experienced by the patient. The contact surface may have

a substantially planar surface, or alternatively may have a slightly curved surface.

Conveniently, the protection member may comprise tapered edges in order to be smoothly guided under a cast. Additionally, tapered edges of the protection member may assist to align and guide the cast material to be cut towards the cutting means. Furthermore, providing a protection member having a tapered leading edge, at least, advantageously allows the protection member to be readily guided between the different layers of the cast material. For example, the protection member may be guided between the rigid layer and fibrous or bandage layer of a cast, thus separating any adhesion between the layers and allowing the cutting means to cut through the rigid layer only. In this case, the leading edge may be tapered on one side or alternatively on both sides of the protection member.

Preferably, the cutting means of the cast-cutter is suitable for cutting various types of casts, including plaster casts and synthetic, glass fibre casts which may comprise glass fibre tape or other similar casting material.

Conveniently, the cutting means may be adapted to cut material by a shearing action by the interaction of first and second portions, each comprising at least one

cutting edge which in use cooperate to produce a shearing strain in a material positioned therebetween.

The cutting means may be adapted to cut a cast in two directions, as required.

The cutting means may be manufactured from any suitable material, such as metal, ceramic or plastic or the like.

In one embodiment of the present invention, the first and second portions of the cutting means each include a single cutting edge.

Preferably, the cutting means comprises a first portion defining an aperture having a cutting edge, and a second portion having a cutting edge and adapted to be received within said aperture, such that when a section of a cast is positioned between said first and second portions, sufficient relative movement therebetween will result in a section of material being sheared from the cast by the cooperating cutting edges. For example, the first portion may define a rectangular aperture having at least two parallel cutting edges, and the second portion may have a rectangular shaped face which corresponds to the rectangular aperture in the first portion, and may have at least two parallel cutting edges for cooperation with those of the first portion.

In one embodiment of the present invention, the first portion may define two apertures each having a cutting edge, and the second portion may define two cutting elements each having a respective cutting edge and adapted to be received within a respective aperture of the first portion. Conveniently, the apertures may be elongated slots and may be aligned parallel to each other. Thus, in use, when a section of cast is positioned between the first and second portions, sufficient relative movement therebetween will result in a strip of cast material being formed between the elongated slots of the first portion and the elements of the second portion. Once the cast-cutter has been translated along the entire length of the cast, a strip from the cast will have been removed allowing the cast to be removed from the patient.

Advantageously, the first portion of the cutting means may be stationary, and the second portion may be moveable, such that in order to effect cutting of a section of a cast, the second portion is moved towards said first portion when the cast is positioned therebetween.

Conveniently, the first portion may be mounted on the protection member or may be integrally formed therewith. Alternatively, the first portion may be

mounted on the connecting member which connects the protection member to the body of the cast-cutter.

Advantageously, the second portion may be mounted on the body and may be reciprocally moveable along a linear path relative to the first portion. In an alternative embodiment, the second portion may be pivotally mounted relative to the first portion and may be moved relative to the first portion along an arcuate path. The second portion may be pivotally mounted on the body, or alternatively on a connecting member coupled between the body and protection member. Alternatively, the second portion may be pivotally mounted on the protection member, or on the first portion of the cutting means, for example. In one embodiment, the connecting member may define a pivot point in the region in which the connecting member is coupled to the protection member.

Advantageously, where the second portion is pivotally mounted on the first portion, the first portion preferably includes a lug which is accommodated in a suitable recess or land area on the second portion. Preferably, the lug and recess arrangement is such that the face of the lug sits substantially flush with a face of the second portion. In this way, any snagging of material being cut by the cutting means will be reduced.

Alternatively further, the second portion may be rotatably mounted relative to the first portion and may be suitably formed and arranged to shear a cast material upon rotation. Preferably, when the second portion operates by rotation, means are provided, either individually, or integrally with the second portion, to assist in moving the cast-cutter along the length of the cast.

Alternatively, the first portion of the cutting means may be moveable, and the second portion may be stationary, such that a section of cast positioned between said first and second portions will be sheared by movement of the first portion towards the second portion.

Alternatively further, the first and second portions may be moveable such that cutting is achieved by movement of the first and second portions towards each other.

Preferably, the cutting means includes a force storage device which acts to provide a positive pressure between the first and second portions of the cutting means. The force storage device may be spring means, for example. Alternatively, the force storage means may be provided inherently by one or both of the first and second portions of the cutting means, such as by providing one or both portions with a longitudinal curvature or profile. The curvature or profile of the

portions, in use, causes an interference engagement therebetween causing one or both portions to slightly elastically deform, wherein the force of elastic recovery within one or both portions acts to bias the portions into contact with each other.

Advantageously, the respective cutting edges of the first and second portions may be provided as or on separate inserts or components which are secured to the first and second portions respectively. Preferably, the inserts are releasably secured to the respective first and second portions. This arrangement is advantageous in that if a cutting edge becomes damaged or inefficient, it may be readily replaced without the need to replace the entire portion upon which the cutting edge is located. Additionally, the provision of cutting edges on separate inserts allows the first and second portions of the cutting means to be manufactured from a first material which does not have to exhibit the required mechanical properties to directly cut a cast material, which would generally be more expensive. The inserts may be manufactured from any suitable material such as plastic, ceramic or metal or the like.

In an embodiment of the present invention, the cutting means may comprise a first portion having a cutting die, and a second portion having at least one

cutting edge, such that when a cast is positioned between said first and second portions, sufficient relative movement therebetween will result in a section of material located directly between the cutting edge of the second portion and the cutting die of the first portion being sheared from the cast. Conveniently, the cutting die may be mounted within the first portion and may define a spherical structure against which the cutting means engages in use. Alternatively, the cutting die may define a truncated conical structure. Advantageously, the cutting die may be loosely mounted within the first portion and be free to be translated to a small degree in at least two dimension, that is in at least one plane. This arrangement may assist in the die being self aligned with the cutting edge of the second portion when in use.

In use, the cutting means of the cast-cutter may shear discrete fragments of material from the cast, such that each cutting action of the cutting means will remove individual segments of material from a cast. Conveniently, where the cast-cutter is adapted to shear discrete fragments of material from a cast, the fragments may be passed through the second portion of the cutting means and subsequently ejected at a location removed from the point of cutting, which would assist to prevent clogging of the cutting means during use.

Alternatively, the discrete fragments removed may be ejected from below or from the rear of the cutting means. Alternatively, a continuous strip of material may be removed from the cast wherein the cutting means is adapted to progressively remove a complete strip from the length of the cast. In one embodiment of the present invention, a leading edge of the second portion of the cutting means which is received in the aperture of the first portion may be chamfered such that during a cutting action, the cast material will not be completely sheared from the cast, allowing a continuous strip of material to be removed. Alternatively, the aperture in the first portion of the cutting means may be open or chamfered at one side to prevent cutting of the cast material at that side. It should be noted that any suitable arrangement may be utilised which would prevent any shearing of the cast material in the region of one side of the first and second portions.

Alternatively, the cutting means may be adapted to remove both discrete fragments of material, and continuous strips from the cast. For example, the cast-cutter may initially be used to remove a continuous strip, which continuous strip may be terminated at any required point by the cutting means. This arrangement may be particularly advantageous for use in the removal

of complex casts wherein the cast-cutter initially removes a continuous strip which is subsequently terminated to realign the cast-cutter to proceed in the removal of the cast.

Conveniently, where the cast-cutter is adapted to remove continuous strips of material from a cast, the first portion of the cutting means may comprise a strip exit to allow a strip of the cast which is being removed to pass therethrough, preventing blockage of the cutting means and assisting in efficient removal of the strip of cast material. The strip exit preferably comprises tapered sides, which sides may taper outwards, away from the aperture of the first portion. Providing the strip exit with tapered edges in this manner assists in the free movement of the strip and prevents the strip from blocking the strip exit. Additionally, the tapered edges allow the cast-cutter to more readily be operated along a curved or arcuate path.

Preferably, the cutting means is operated by electric drive means. Alternatively, the cutting means is operated by hydraulic drive means. Alternatively further, the cutting means may be operated by pneumatic drive means. It should be noted, however, that any suitable drive means may be used which would readily be selected by a person of skill in the art.

Advantageously, the cast cutter may be powered by an electrical power supply, such as a mains supply either alone or in combination with a transformer and/or a rectifier, or alternatively, or indeed additionally, by a local power supply such as a battery pack. Preferably, where the cast-cutter is powered by a battery pack, the battery pack is rechargeable. Additionally, the battery pack may be removable from the cast-cutter for recharging, replacing or disposal or otherwise.

Advantageously, the cast-cutter includes visual signal means which are activated when power is supplied thereto. Such visual signal means may be in the form of an LED or the like.

Conveniently, the cast-cutter may be activated by depressing or otherwise closing a normally open switch, and deactivated by releasing the switch.

Preferably, the cast-cutter comprises at least one safety switch which has to be depressed or released before the main switch can be operated. This prevents the cast-cutter from being inadvertently activated by accidentally depressing the main switch.

Preferably, the cast-cutter further comprises a safety guard disposed around the cutting means to prevent accidental injury by trapping a finger, for example, while the cutter is in use. The guard may be fixed in

place or alternatively may be retractable to allow access to the cutting means for cleaning or maintenance, for example. Conveniently, where the safety guard is retractable, the guard may include a safety switch such that the cast-cutter may only be operated when the safety guard is positioned correctly in place.

Preferably, the safety guard is transparent such that the cutting means may be safely viewed by a user to ensure correct operation and that a correct line of cut is being achieved.

Advantageously, the cast-cutter may further comprise means for collecting the sections of a cast which have been removed. The collecting means may comprise a container releasably attached to the body portion of the device. Alternatively, the collecting means may be a separate receptacle located remote from the cast-cutter and connected thereto by a flexible tubular member or conduit or the like.

Conveniently, the cast-cutter may comprise extraction means such as a vacuum unit which may assist in drawing the removed fragments or strips of the cast into or towards any associated collecting means.

While removing a cast from a patient using a shearing action as opposed to a sawing action will significantly reduce the amount of dust produced, it is

inevitable that some dust may be created. However, the presence on an extraction means may assist to control and contain any dust produced. Conveniently, the extraction means may be provided with a suitable filtration unit for assisting in collecting any dust particles produced during use of the cast-cutter.

Advantageously, the various components of the cast-cutter may be coated with a material to prolong service life or to allow ease of cleaning or the like. For example, a Teflon® coating may be utilised.

According to a second aspect of the present invention, there is provided a method of removing a cast from a patient, said method comprising the steps of:

providing a cast cutter having shearing cutting means and a protecting member;

placing the protecting member adjacent to the skin of the patient such that the protecting member is located between the skin of the patient and the cutting means;

aligning the cutting means with the end of the cast; and

activating and moving said cast-cutter along the length of the cast to remove a strip of material therefrom, allowing the cast to be removed from the patient.

Preferably, the method further comprises the steps of:

placing the protecting member of the cast-cutter adjacent to the skin of the patient and aligning the cutting means with an alternative end portion of the cast; and

activating and moving the cast-cutter along the length of the cast to allow the cast to be removed in two portions.

The above steps may be repeated as required in order to safely remove the cast from the patient.

According to a third aspect of the present invention, there is provided a cast-cutter for use in removing a cast from a patient, the cast-cutter comprising:

a body;

cutting means supported by the body and adapted for cutting a cast material by an abrasion action; and

a protection member supported by the body and adapted to be positioned between the cutting means and the patient, to protect the skin of the patient.

Thus, in use, the cutting means and the protecting member may be aligned with the end of a cast and the cast-cutter subsequently activated and moved along the cast in the required cutting direction. In this way,

while the cutting means abrades the cast material, the protecting means slides underneath the cast to protect the skin of the patient from injury from the cutting means.

Conveniently, the cast-cutter may be used in the removal of a cast from a patient by cutting along the length of one side of the cast or alternatively, and preferably opposing sides of the cast such that the cast may be removed in two portions. Alternatively, the cast-cutter may be used to cut along the length of a single side of the cast with the cast subsequently being spread in a conventional manner and removed from the patient.

Preferably, the cutting means includes at least one cutting disc suitably mounted on the body of the cast-cutter. The at least one cutting disc may be rotatably mounted on the body. In one embodiment of the present invention the at least one cutting disc may be rotated about an axis of rotation to effect cutting of a cast. Alternatively, the at least one cutting disc may be oscillated about an axis of rotation to effect cutting of a cast material. The cutting means may include one cutting disc. In an alternative embodiment, the cutting means may include two cutting discs mounted and movable about a common axis of rotation.

Alternatively, the cutting means may include at least one cutting rod rotatably mounted between the body and protection member, wherein the outer circumferential surface of the cutting rod is adapted in use to cut a cast material by a process of abrasion.

Advantageously, the cutting means may be driven by electric drive means such as an electric motor or the like. Alternatively, the cutting means may be driven by hydraulic or pneumatic drive means, or any other suitable drive means available in the art.

Preferably, the protection member is secured to the body of the cast-cutter by a connection member, one end of the connection member being secured or coupled to the body, and another end of the connecting member being secured or coupled to the protection member. Advantageously, the connecting member is adapted to pass through any slot or gap created in a cast material by the cutting means. In one embodiment, the connecting member may be adapted to exert a force on the walls or edges of any slot or gap through which the connection member passes, in order to force apart or spread the edges of the slot or gap. This particular feature may therefore assist in preventing the cutting means from binding or being trapped within the slot which is being cut, allowing for improved and easier operation.

Conveniently, a single connection member may be provided. Alternatively, two or more connecting members may be provided, wherein each connecting member is adapted to pass through a respective slot or gap created in a cast material by the cutting means. Thus, where the cutting means comprises two cutting discs, for example, there may be provided two connecting members.

Advantageously, the protection member may be pivotally mounted on the body of the cast-cutter. In this way, relative movement between the cutting means and the protection member may be achieved, allowing the cast-cutter to be effectively utilised on casts of varying thickness. Additionally, the cutting means may be removed from the particular slot being formed or cut in the cast while maintaining the protection member under the cast. In this way, the cutting means may be retracted from the cast material for inspection, cleaning or replacement or the like, without having to withdraw the protecting member from under the cast.

The cast-cutter according to the third aspect may comprise various preferred and optional features such as those described above with reference to and in accordance with the first aspect of the present invention. Thus, for the purposes of brevity, these preferred and optional features have not been repeated.

According to a fourth aspect of the present invention, there is provided a method of removing a cast from a patient, said method comprising the steps of:

providing a cast cutter having abrading cutting means and a protecting member;

placing the protecting member adjacent to the skin of the patient such that the protecting member is located between the skin of the patient and the cutting means;

aligning the cutting means with an end of the cast; and

activating and moving the cast-cutter along the length of the cast to cut through the cast, allowing the cast to be removed from the patient.

The cast may be cut any number of times by the cast-cutter in order to safely remove the cast from the patient.

These and other aspects of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a cast-cutter in accordance with an embodiment of the present invention;

Figures 2 to 18 show various embodiments of cutting means of the cast-cutter shown in Figure 1;

Figures 19a, 19b, 19c, 20 and 21 show a portion of cutting means for use in the cast-cutter shown in Figure

1 in accordance with alternative embodiments of the present invention;

Figure 22 shows a perspective view of a safety guard for use with the cast-cutter shown in Figure 1;

Figures 23 to 26 show further alternative embodiments of cutting means of a cast-cutter according to an aspect of the present invention;

Figures 27 and 28 show alternative embodiments of a protective shoe of a cast-cutter according to the present invention;

Figures 29 to 32 show alternative embodiments of cutting means and protective shoes in accordance with an aspect of the present invention;

Figure 33 is a diagrammatic representation of a removable protective shoe in accordance with an embodiment of a present invention;

Figure 34 is a diagrammatic representation of a cover for use with a protective shoe in accordance with an embodiment of the present invention;

Figures 35 to 57 show various embodiments of cutting means which operate in a pivoting motion in accordance with the present invention;

Figures 58 to 63 show various embodiments of drive mechanisms for use with cutting means in accordance with the present invention;

Figure 64 is a perspective view of a cast material with a cut area;

Figure 65 is an elevation view of a cast material with a portion of a cast-cutter according to an embodiment of the present invention shown when in use;

Figures 66 to 70 show various embodiments of a cast-cutter according to the present invention; and

Figures 71 to 76 show various embodiments of cutting means which operate in a linear reciprocating motion in accordance with the present invention.

Reference is first made to Figure 1 of the drawings in which there is shown a cast-cutter 10 in accordance with one embodiment of the present invention. The cast-cutter 10 is shown in use removing a cast 12 from a body part 14 of a patient. The cast-cutter 10 comprises a protective shoe 16 and cutting means 18 which are both supported by a body portion 20 of the cast-cutter 10. As shown, the protective shoe 16 is positioned between the cutting means 18 and the body part 14, thus protecting the patient from injury during operation.

The cast-cutter 10 further comprises a main switch 22 and a safety switch 23, both located on a handle 24, said switches 22, 23 for activating the cutting means 18. In the embodiment shown, the cast-cutter 10 is operated by electric drive means and is provided with electrical

energy via electrical cable 26. As shown, the handle 24 is aligned with the intended direction of cut which provides a user with improved control when using the cast-cutter 10.

As shown in Figure 1, the protective shoe is supported by the body portion via a connecting member 28 which is coupled at one end to the body portion 20 and at another end to the protective shoe 16.

In use, the protective shoe 16 may be placed against the skin of the patient's body part 14 with the cutting means 18 aligned with an end portion of the cast 12. Once in position, the cutting means 18 is activated by depressing switch 22, in combination with the safety switch 23, and the cast-cutter 10 is moved along the length of the cast 12, with the protective shoe sliding under the cast 12, to remove a strip of material therefrom without the possibility of the cutting means 18 causing injury to the patient. The cast-cutter 10 preferably includes a safety guard as described hereinafter with reference to Figure 18.

The cutting means 18 shown in Figure 1 effects cutting of the cast 12 by a shearing action. In the embodiment shown, the cutting means 18 comprises a first, fixed portion 30 formed integrally with the protective shoe 16, and a second portion 32 reciprocally mounted on

the body portion 20 of the cast-cutter 10. The fixed portion 30 defines an aperture 38 (Figure 2) having a cutting edge 39 (Figure 2), which aperture 38 is adapted to receive a cutting edge 34 of the second portion 32 of the cutting means 18. Thus, when a cast 12 is positioned between the first and second portions 30, 32 of the cutting means 18, and the cutting means 18 is activated, interaction between the cutting edge 34 of the second portion 32 with the cutting edge 39 of the aperture 38 in the fixed portion 30 will result in a section of the cast being sheared therefrom. Thus, the reciprocating motion of the second portion 32 of the cutting means 18 in combination with the advancing movement of the cast-cutter 10 along the length of the cast 12 will result in a strip of the cast being removed.

A detailed description of various embodiments of the cutting means 18 of the present invention will now be described with reference to Figure 2 to 14.

Referring initially to Figure 2, there is shown a simplified perspective view of the cutting means 18 of a cast-cutter in accordance with an embodiment of the present invention. The cutting means 18 comprises a fixed, first portion 30 defining a rectangular aperture 38 having two parallel cutting edges 39, the fixed portion 30 adapted for receiving a second portion 32

having a generally rectangular shaped face which corresponds to the rectangular aperture 38 in the first portion 30, and has two parallel cutting edges 34 for cooperation with the cutting edges 39 of the first portion. The second portion 32 is reciprocally mounted on the cast-cutter (not shown) and will cut a portion of material from the cast on a down-stroke. It should be noted that the term "down-stroke" used in this context relates to the direction of movement of the second portion 32 with respect to the orientation of the representation. However, in more general terms, down-stroke should be understood to mean a stroke of the second portion 32 in an outward direction relative to the body of the cast-cutter. Thus, a section of material which is sheared from the cast will be ejected from below the fixed portion 30.

Referring now to Figure 3, an alternative cutting means will be described. As in the embodiment shown in Figure 2, the cutting means comprises a fixed portion 44 defining an aperture 46 having cutting edges 47 (only one shown), within which aperture 46 is received a moveable portion 48 which is reciprocally mounted on the cast-cutter. The moveable portion 48 includes cutting edges 50, which cutting edges cooperate with the cutting edges 47 of the aperture 46 to shear material from the cast

being removed. In the embodiment shown in Figure 3, the moveable member 48 cuts the cast on its upstroke, and ejects the sheared section of cast from above the aperture 46 in the fixed portion 44.

A further arrangement is represented in Figure 4 wherein a cutting means is shown which comprises a stationary first portion 52 having an aperture 54, and a moveable second portion 56 which is pivotally mounted in said aperture 54 via pivot pin 58. In use, a portion of a cast to be removed is positioned between the first and second portions 52, 56 and the moveable portion 56 is pivoted within said aperture 54, such that the cast is sheared by respective cutting edges 60, 62 of the aperture 54 and the second portion 56. As with the embodiment shown in Figure 2, the sheared cast portion is ejected from below the first portion 52.

A still further arrangement is shown in Figure 5 in which a cutting means is shown which comprises a stationary first portion 120 defining two elongated apertures or slots 122, and a moveable second portion 124 which is reciprocally mounted on the body (not shown) of the cast-cutter. The second portion 124 comprises two cutting extension 126 extending from the lower end thereof, wherein the cutting extension 126 are each adapted to be received within a respective slot 122.

Thus, when a cast material is located between the first and second portions 120, 124 of the cutting means shown in Figure 5, and the cutting means is activated, the cutting means will cut through the cast. In this way, a strip of cast material will be formed between the cutting extensions 126.

The first portion is secured to the body (not shown) of the cast cutter by two connecting members 128 positioned adjacent each other and spaced apart by at least the same distance as the slots 122. This arrangement allows any strip of cast material formed by the cutting means to pass between the connecting members 128 and subsequently be removed without causing any blockage.

Referring to Figure 6, an alternative cutting means will now be described. The cutting means shown includes a first, stationary portion 130 supported by the body (not shown) of the cast-cutter, and a second, moveable portion 132 which is mounted on the body of the cast-cutter and is adapted to either reciprocate and/or pivot with respect to the stationary portion 130. In the embodiment shown in Figure 6, the first portion 130 defines a single cutting edge 134, and the second portion 132 also defines a single cutting edge 136 corresponding to, and aligned with cutting edge 134 of the first

portion 130. In use, cutting edges 134, 136 cooperate to cut a cast material located therebetween.

A similar arrangement to that shown in Figure 6 is shown in Figure 7, and as such like components share like reference numerals. The structure and operation of the cutting means shown in Figures 6 and 7 is similar, with the exception that the first, stationary portion 130 shown in Figure 7 includes a front extension or guard 138. In use, the front guard 138 prevents a patient's skin, for example, from becoming trapped between the cutting edges 134, 136 of the first and second portions 130, 132 respectively.

Reference is now made to Figures 8(a) and (b) in which there is shown a cross-sectional side view and a bottom view respectively of a cutting means of a cast-cutter in accordance with one embodiment of the present invention. The cutting means 18 is similar to that shown in Figure 2 in that it comprises a fixed first portion 64 defining an aperture 66 for receiving a second moving portion 68. The cutting means 18 shown in Figure 8 is adapted for cutting a strip 70 of material from a cast 12, wherein the strip 70 is ejected from the fixed portion 64 through a strip exit 72. The leading edge of the second portion 68 is chamfered 74 such that during a cutting action, the cast material will not be completely

sheared from the cast, allowing a continuous strip 70 to be removed. It should be noted that the term "continuous" as used above implies that during a cutting action of the cutting means 18, a portion of the strip 70 being removed remains attached to the cast 12. However, the cutting means 18 may be adapted to completely shear the strip 70 from the cast 12, for example, when it is required to terminate the strip 70 to remove the cast-cutter or to change the direction of the cast-cutter.

The upper 110 and side walls 112 of the strip exit 72 are outwardly tapered to allow the cast-cutter to readily be moved in an arcuate or curved path when in use, and also to prevent the strip 70 from blocking the strip exit 72.

A similar embodiment to that shown in Figure 8 is shown in Figure 9, the difference being the existence of a floor portion 76 which closes the underside of the aperture 66 in the fixed portion 64. The floor portion 76 guides the strip 70 towards the strip exit 72 and when the fixed portion is mounted on, or forms part of the protective shoe, the floor portion 76 prevents the sheared cast material from being ejected towards and against the skin of the patient. Additionally, the floor portion may also provide a barrier between the second, moveable member 68 and the patient's skin.

The upper 110, lower 114 and side walls 112 of the strip exit 72 of the embodiment shown in Figure 9 are outwardly tapered for the same reasons as discussed above with reference to Figure 8.

Figure 10 shows a similar arrangement to that of Figures 8 and 9. However, the fixed portion, identified as numeral 140 in Figure 10 includes a downwardly tapered rear surface 142 to assist in moving a strip 144 removed from the cast 146 away from the cutting means, generally indicated by reference numeral 148. As shown, the rear edge 143 if the tapered surface is rounded to prevent catching on the cast material being removed, or alternatively to prevent catching or snagging when the cast-cutter and thus stationary portion 140 is retracted from under the cast 146.

Reference is now made to Figure 11 in which there is shown a cross-sectional diagrammatic representation of a cutting means 150 in accordance with an embodiment of the present invention. The cutting means 150 is specifically adapted to remove discrete segments from a cast and comprises a first portion 152 fixed to the body (not shown) of the cast-cutter via a connection member 154, and a second portion 156 reciprocally mounted on the body of the cast-cutter. The second portion defines a cutting edge 158 and an internal bore 160. In use, a portion of

a cast material located between the first and second portions 152, 156 is cut and is forced inside the bore 160 of the second portion 156. As cutting of the cast continues, each new portion removed from the cast will be forced inside the bore 160, resulting in existing cast material being forced further into the bore 160. In this way, the material cut from the cast may be forced away from the cutting means 150 towards a point of extraction or collection. In Figure 11, the material cut from the cast will exit from the rear of the second portion. However, the material may exit from the front of the second portion as shown in Figure 12. The extraction process may be assisted by a vacuum device (not shown) adapted to draw the cast portions removed from the cast upwards through the bore 160 of the second portion 156.

A similar embodiment to that shown in Figure 11 is shown in Figure 13, wherein like components share like reference numerals. In this embodiment, the first portion 152 includes a cutting die 300 mounted therein. The cutting die 300 incorporates a truncated conical structure which is adapted to cooperate with the cutting edge 158 to shear a cast material. The cutting die 300 is loosely mounted within the first portion 152 such that it may be aligned with the cutting edge 158 of the second portion 156. Additionally, a gap 302 is provided beneath

the cutting die 300 in order to allow the cutting die 300 to be depressed into the first portion 152. Although not specifically shown, the gap 302 is preferably provided with a resilient member in order to provide the cutting die 300 with shock absorption means to prevent damage thereto from prolonged use.

A similar embodiment is shown in Figure 14 wherein a cutting die 304 is provided mounted within the first member 152, wherein the cutting die 304 defines a domed, conical or spherical structure.

Referring now to Figure 15, there is shown another similar embodiment to that of Figure 11. In this embodiment, the cutting edge 158 of the second portion 156 is provided on a removable tip portion 306, such that the tip portion 306 may be readily replaced when the cutting edge 158 becomes worn.

A cutting means 162 according to an alternative embodiment of the present invention is shown in Figure 16, and comprises a fixed first portion 164 defining an aperture 166, and a reciprocating second portion 168 having two parallel cutting extensions 170 which cooperate with the aperture 166 in the first portion 164 to cut a cast material. As shown, the second portion 168 includes a relief 172. The form of the second portion is shown in the cross-sectional view of Figure 17, wherein a

channel 174 is defined between the cutting extensions 170 (only one shown in Figure 17). This particular form of the second portion 168 is advantageous in that the force exerted on the cast by the cutting means 162 as a whole will be maximised in the required region of cut, that is, in the region around the edge of aperture 166.

The relief 172 in the second portion allows access into the channel 174 to dislodge any cast material which may have become trapped therein, as represented in Figures 18(a) and (b). In Figure 18(a), a strip of cast material 176 is shown trapped within the channel 174. However, the presence of relief 172 allows a dislodging device 178 to by forced into the channel 174 to release the strip 176, as shown in Figure 18(b).

Various alternative forms of moveable second portions of cutting means for use on a cast-cutter of the present invention will now be described with reference to Figures 19 to 21. Referring first to Figures 19(a) to (c), there is shown side, rear and bottom views respectively of a moveable portion 78. The moveable portion 78 includes curved cutting edges 80 which curve downwards from a leading edge 82 to a trailing edge 84 of the moveable portion 78. As shown more clearly in Figures 19(b) and (c), the moveable portion comprises a channel 86 located between the cutting edges 80, such

that, in use, the area of the contact surfaces 88, 90 is reduced which increases the cutting pressure which is exerted on the cast by the moveable member 78. Additionally, the contact surfaces 88, 90 assist in preventing the cast material from slipping during a cutting action.

An alternative moveable member 92 is shown in Figure 20. In this embodiment, the cutting edge 94 is serrated, such that, when in use, a number of contact points are created, which provides for improved gripping of the cast material and improved mechanical cutting properties. For example, the cutting force imparted by the cast-cutter will be distributed by point loading onto the cast material, which will maximise the cutting pressure exerted on the cast and will better induce crack propagation, particularly in rigid cast material.

A further alternative embodiment is shown in Figure 21, wherein the cutting edge 98 of the moveable member 96 is curved in an arch profile between leading 100 and trailing 102 edges of the moveable portion. This particular form of moveable member 96 is advantageous particularly in the removal of individual discrete portions of the cast material, as opposed to complete strips, as cutting will be effected initially from the leading and trailing edges 100, 102, and then

progressively by the side edges of the member 96 towards its centre, and will again maximise the cutting pressure. Although not apparent from Figure 21, the moveable member 96 may have a similar channel to that channel 86 shown in Figures 19(b) and (c). Again, the specific shape of the moveable portion 96 will assist in gripping the cast material when the cast cutter is in use.

Reference is now made to Figure 22 in which there is shown a simplified perspective view of cutting means of the present invention including a safety guard 104 located around the moveable member 106, and above the fixed member 108. In use, the guard 104 is moved into place in order to prevent injury by trapping a finger or the like and to prevent portions of cast material being discharged from the cutting means. The safety guard 104 includes an additional safety switch (not shown), which only allows the cast-cutter to be operated when the guard 104 is securely and properly located in its guarding position. Additionally, the safety guard 104 is manufactured of a substantially transparent material such the cutting means may be viewed when the cast-cutter is in use.

Further alternative embodiments of cutting means of the cast-cutter according to the present invention will now be described with reference to Figures 23 to 26. As

with previous described embodiments, the cutting means includes a stationary portion and a moveable portion, and as such in the embodiments shown in Figures 23 to 26, the stationary portion will be identified with reference numeral 180, and the moveable member with numeral 182.

Referring initially to Figure 23, the stationary member 180 comprises an aperture 184 defined by an insert 186 which incorporates cutting edges 188. When the cutting edges 188 become worn, the insert 186 may be removed and replaced, without having to replace the entire stationary portion 180. A similar arrangement is shown in Figure 24, wherein two separate inserts 190 are provided in the stationary member 180. Referring now to Figure 25, the moveable portion 182 defines cutting edges 192 which are provided on a removable cutting extension 194 which is secured to the moveable portion 182, in the embodiment shown by a locating profile 195 and a suitable fixing 196. Thus, as the cutting edges 192 become worn, the cutting extension 194 may be readily replaced without having to replace the entire moveable portion 182. A similar arrangement is shown in Figure 26 wherein cutting edges 198 are provided on two separate cutting extensions 200 which are secured by suitable fixings 202 to the moveable portion 182.

Referring now to Figures 27 and 28 there is shown two alternative forms of a protective shoe 204, 206 respectively, in accordance with embodiments of the present invention. The protective shoe 204 shown in Figure 27 incorporates a profiled nose 208 having an upper tapered surface 210. In use, the tapered surface 210 of the profiled nose 208 allows the protective shoe 204 to more readily be guided under and along a cast 212, between the cast 212 and a body portion 214 or a patient.

The protective shoe 206 shown in Figure 28 also incorporates a profiled nose 216. However, in this specific embodiment the nose 216 is defined by an upper and a lower tapered surface 218, 220. Thus, the nose 216 shown in Figure 28 is in the form of a wedge which allows the protective shoe 206 to be more readily inserted between two layers of a cast 222, in order to separate the layers. For example, and as shown in Figure 28, the protective shoe 206 may be inserted between a soft wadding or bandage layer 224 and a rigid layer 226 of the cast 222, with the cutting means (not shown) of the cast-cutter being used to cut through the rigid layer only.

An embodiment of a cutting means 230 of a cast-cutter in accordance with an aspect of the present invention is shown in Figure 29. While the various arrangements described above involve cutting means

adapted to cut a cast material using a shearing action, the cutting means 230 of Figure 29 is adapted to cut a cast material using an abrading action. The cutting means includes a cutting disc 232 mounted on a shaft 234. Although not specifically shown, the disc 232 and shaft 234 may be secured by any suitable means to the body of a cast-cutter, such as that shown in Figure 1. The cutting disc may be adapted to rotate or oscillate on the shaft 234 in order to effect cutting of a cast.

A protective shoe 236 for use in combination with the cutting means 230 is also shown in Figure 29. The protective shoe 236 may be secured to the body of a cast-cutter via a connecting member 238 which is sized and arranged to pass through any slot or channel or the like created in a cast by the cutting disc 232. Thus, the protective shoe 236 may be located under and translated along the length of a cast to protect the skin of a patient from injury by the cutting disc 232.

A similar arrangement is shown in Figure 30 with the exception that two cutting discs 240 are provided, along with two connecting members 242 aligned with a respective disc 240. Thus, in use, the cutting discs 240 form a strip of cast material therebetween, which strip of cast material is free to pass between the connecting members 242, thus preventing any blockage.

Reference is now made to Figures 31 and 32 in which there is shown an alternative arrangement of a protective shoe 244 for use in particular with a cutting disc 246. The protective shoe 244 is pivotally mounted on a body (not shown) of a cast-cutter at pivot point 245 by way of a connecting member 248, one end of which is fixed to the protective shoe 244 and the other end of which is pivotally mounted on the body at point 245. This arrangement allows the distance between the protective shoe 244 and the cutting disc 246 to be varied in accordance with the thickness of the cast 250 to be cut, for example. Additionally, pivotally mounting the protective shoe 244 on the body of a cast-cutter will allow the cutting disc 246 to be removed from the cast material 250 being cut, without having to retract the protective shoe 244 from underneath the cast.

A side view of the protective shoe 244, connecting member 248 and cutting disc 246 of Figure 31 is shown in Figure 32. As shown, the connecting member 248 includes a widened portion 252 which in use assists to spread apart the cast which is being cut by the disc 246 in order to minimise or substantially prevent the disc 246 from becoming trapped within the cast material.

It should be understood that the embodiments hereinbefore described are merely exemplary of the

present invention and that various modifications may be made thereto without departing from the scope of the invention. For example, any fixed portion of the cutting means may be mounted separately from the protective shoe, for example on the connecting member which connects the protective shoe to the body portion of the cast-cutter. Additionally, a collector may be provided which collects and retains the cuttings of cast which are removed during operation. The collector may be mounted on the cast-cutter or alternatively may be located separately therefrom. Additionally, extraction means may be provided to assist in collecting the portions of cast which have been removed, along with any dust. The extraction means may be a vacuum unit or the like.

Furthermore, the cast-cutter may be powered by a battery pack or the like mounted on or in the body of the cast-cutter.

In the embodiments shown which operate to cut a cast material by a shearing action, the cutting means operates by relative reciprocal or pivotal motion between the first and second cutting portions. However, cutting may be effected by a relative rotational motion or the like. Additionally, the cutting means, in use, may also assist in moving the cast-cutter along the length of the cast.

The cast-cutter may additionally comprise control means in association with sensing means which allow the cutting means of the cast-cutter to only be activated when a cast section is located between the first and second cutting portions.

Furthermore, the protective shoe of the cast-cutter may be removable to allow replacement. A general representation of this feature is shown in Figure 33 which shows a protective shoe 252 secured to a connecting member 254 via suitable fixings 256 which allow the protective shoe to be removed and replaced as required. Alternatively, a cover 258, shown in Figure 34, may be secured over the protective shoe 260 such that only the cover 258 need be replaced, for example when the cast-cutter is to be used on different patients.

Reference is now made to Figure 35 in which there is shown a diagrammatic side view of cutting means, generally represented by reference numeral 300, of a cast-cutter in accordance with an alternative embodiment of the present invention. The cutting means 300 includes a fixed first portion 302 mounted on a connecting member 304, which connecting member 304 couples the first portion 302 to a body of the cast-cutter (not shown). The first portion defines a single cutting edge 306. The cutting means 300 also includes a second portion 308

pivotally mounted on a pivot 309 secured to the connecting member 304, wherein, in use, the pivot is located above any material being cut. The second portion defines a single cutting edge 310 such that when the second portion 308 is pivoted on the connecting member, cooperation of the cutting edges 306, 310 will cause any cast material located therebetween to be cut by a shearing action. In use, the arrangement shown in Figure 35 will cause a single line of cut to be made in a cast material.

Reference is now additionally made to Figure 36 which is a cross-sectional view of the cutting means 300 of Figure 35, taken through line 36-36. As shown, the pivot 309 is provided by a nut and bolt arrangement 312 (this arrangement 312 is not shown in Figure 35 for clarity). Also shown is a spring 314 compressed between part of the nut and bolt arrangement 312 and the second portion 308 of the cutting means 300. The spring 314 acts as a force storage means and in use biases the second portion 308 against the first portion 302 to assist in preventing separation of the portions 302, 308 and to ensure an efficient cutting action is achieved and maintained.

An alternative embodiment of cutting means is shown in Figure 37, designated by reference numeral 314, which

is similar to that shown in Figure 35 with the exception that a second portion 316 of the cutting means is mounted on a pivot 318 which is positioned below the line of cut. A cross-sectional view through line 38-38 of Figure 37 is shown in Figure 38. Although not shown, the cutting means 314 may include a nut and bolt arrangement and a spring as shown in Figure 36.

A further alternative embodiment of cutting means 320 is shown in Figures 39 and 40. Figure 39 is a partial cross-sectional view through line 39-39 of Figure 40, and Figure 40 is a cross-sectional view through line 40-40 of Figure 39. In this embodiment, a second cutting portion 322 defines an arcuate slot 324 through which a support member 326 extends to support a first cutting portion 328. The second portion 322 is pivotally mounted on a connecting member 330 using a nut and bolt arrangement 332, which is provided in combination with a force storage spring 334. The support member is also secured to the connecting member 330, and defines an aperture 336 through which the nut and bolt arrangement 332 may extend.

Referring now to Figure 41, an alternative cutting means 338 is shown which includes a stationary first cutting portion 340 having first and second linearly aligned cutting edges 342, 344, and a second cutting

portion 346 pivotally mounted on a connecting member 348 via pivot 350. The second cutting portion 346 defines first and second cutting edges 352, 354 adapted to cooperate with respective cutting edges 342, 344 of the first cutting portion 340. Additionally, the second cutting portion 346 defines an arcuate slot 356 through which a support member 358 extends to engage and support the first cutting portion 340. The support member 358 is secured to the connecting member 348, such that the arrangement is similar to that shown in Figures 39 and 40. The embodiment shown in Figure 41 is specifically adapted to cut a cast material in two opposite directions, providing a more versatile cast-cutter.

A further cutting means embodiment 360 is shown in Figures 42 and 43; Figure 42 is a cross-sectional view through line 42-42 of Figure 43, and Figure 43 is a cross-sectional view through line 43-43 of Figure 42. The cutting means 360 includes a stationary first cutting portion 362 having a cutting edge 364, and a second cutting portion 366 also having a cutting edge 368 for cooperating with the cutting edge 364 of the first portion 362. The second portion 366 is pivotally mounted on a support member 370 by way of a cantilever pivot pin 372 extending from a blind bore 374 in the support member 370. The support member is secured to a connecting

member 376 which extends from a body (not shown) of a cast-cutter. A spring 378 is mounted within the blind bore 374 and acts to bias the second cutting portion 366 against the first cutting portion 362 to achieve and assist to maintain an efficient cutting action between portions 362, 366.

Another embodiment of a cutting means 380 for use in a cast-cutter according to the present invention is shown in Figures 44 and 45; Figure 44 is a cross-sectional view through line 44-44 of Figure 45, and Figure 45 is a cross-sectional view through line 45-45 of Figure 44. In this embodiment the cutting means 380 includes first and second cutting portions 382, 384, wherein the second portion 384 is pivotally mounted with respect to the first portion 382 by way of a pivot shaft 386 extending from a support member 388, which support member 388 is secured to a connecting member 390 which extends from a body (not shown) of the cast cutter. The pivot shaft 386 is secured to the first cutting portion 382 such that the first portion 382 is supported by the supporting member 388. A spring 392 is mounted within an annulus 394 around the pivot shaft 386, wherein the spring acts as a force storage device to bias the first and second portions 382, 384 into engagement.

Reference is now made to Figure 46 which is a diagrammatic representation of a cutting means 396 for a cast-cutter in accordance with an alternative embodiment of the present invention. This embodiment is similar to that shown in Figure 41 with the exception that a second cutting portion 398 is pivotally mounted on a first cutting portion 400 via pivot 402. As in the embodiment of Figure 41, cutting means 396 allows cutting in two opposing directions.

A general representation of the cutting means shown in Figures 35 to 46 is shown in Figures 47 and 48. As shown, a first cutting portion 404 includes a generally horizontal cutting edge 406, wherein a second cutting portion 408 includes a curved cutting edge 410. Selection of a suitable curvature of this cutting edge 410 is important; a larger radius of curvature or "straighter" curve requires an increased level of force to be applied to effect a cut, whereas a smaller radius of curvature or "tighter" curve may result in a material being forced outwards in the direction of arrow 412. Thus, an optimum blade profile should be selected which provides an efficient cutting action. Furthermore, careful selection of the slope 414, 416 of the respective cutting edges 406, 410 should be made in order to achieve the optimum sharpness; if the slope 414, 416 is too

shallow then cutting may not be achieved, whereas if the slope 414, 416 is too steep then this may result in excessive wear on the cutting edges 406, 410, and may cause the edges to bind with each other.

A further alternative cutting means arrangement 418 is shown in Figure 49. In this embodiment, a stationary first cutting portion 420 includes a lug 422, upon which lug 422 a moveable second portion 424 is pivotally mounted. The second portion 424 includes a land region or recess 426 which accommodates the lug 422. The recess 426 is arranged such that when the first and second portions 420, 424 are secured together, the surface 428 of the lug sits substantially flush with the surface 430 of the second portion 424 in order to present a low profile to any material being cut to minimise snagging of the material on the cutting means 418.

Reference is now made to Figures 50 and 51 which show a cutting means 432 for use in a cast-cutter in accordance with an embodiment of the present invention. The cutting means 432 includes first and second cutting blades 434, 436 arranged to pivot relative to each other at pivot point 438, provided by a nut and bolt arrangement 440. A spring 442 is provided in combination with the nut and bolt arrangement to act as a force storage device and provide a pressing force between the

blades 434, 436 to assist in preventing splaying of separation of the blades when in use. The blades 434, 436 are shown in an open or "non-cut" position in Figure 50, and in a closed or "cut" position in Figure 51. Each blade 434, 436 is formed with a longitudinal profile to cause an interference engagement between the blades when moved from an open position to a closed position. This interference causes the spring 442 to become compressed, as shown in Figure 51, which results in a greater spring force being applied between the blades, to further assist in preventing separation of the blades 434, 436 during cutting. Such a longitudinal profile may also be provided on the opposite side of the pivot point 438, in region 446 (that is, the portion of the blades 434, 436 extending to the left of the pivot point 438 in Figures 50 and 51).

An alternative embodiment to that shown in Figures 50 and 51 is shown in Figures 52 and 53, wherein like components share like reference numerals. In this embodiment, the blades 434, 436 are longitudinally curved (Figure 52), such that when the blades are moved towards a closed position the blades become straightened, as shown in Figure 53, resulting in a force being applied between the blades, with the force being contained by the nut and bolt arrangement 440. This force assists to

prevent the blades 434, 436 becoming separated during a cutting operation. This arrangement therefore eliminates the requirement for the spring 442 shown in Figures 50 and 51. The blades 434, 436 may also be curved on the opposite side of the pivot point 438, identified as region 446, to provide this same effect.

Referring now to Figure 54, there is shown a cross-sectional diagrammatic representation of a cutting blade 450 for use with a cutting means of a cast-cutter in accordance with an embodiment of the present invention. The blade includes a cutting edge 452 and an inner face 454 which is aligned from a cutting plane 456 at an angle 458, generally termed a relief angle. This relief angle 458 may be applied to each blade of the cutting means, as shown in Figure 55, which ensures that once the cutting edges 452 of the blades 450 have made a cut, the inner faces 454 no longer engage and establish a slight clearance 458 for the remainder of the cutting action, as shown in Figures 56 and 57. This arrangements provides a more efficient cutting action and substantially reduces any binding of the material in the blades 450.

A drive mechanism for a cutting means having a pivoting cutting action is shown in Figure 58, wherein a pivotally mounted cutting blade 460 is coupled to reciprocating drive means by a link 462 attached to a

front portion of the blade 460. An alternative embodiment is shown in Figure 59 wherein a link 464 is attached to an extension portion 466 extending from the rear of the blade 468. Where appropriate, the reciprocating drive means may be coupled directly to the blade 460, 468, without requiring a link 462, 464.

Alternative drive mechanisms are shown in Figures 60 and 61, wherein a pivoting blade 470 includes an extension portion 472 extending from an upper surface of the blades 470, wherein a reciprocating drive mechanism such as a drive shaft and swash plate engages the extension portion 472 to cause motion in the direction of respective arrows 474, 476. The embodiment shown in Figure 61 differs from that shown in Figure 60 in that a spring 478 is provided which applies a return force on the extension portion 472 to cause or assist in the return of the extension portion 472 and blade 470 in the opposite direction to that designated by arrow 476.

A further alternative drive mechanism is shown in Figure 62, wherein a pivotally mounted cutting blade 480 includes an upper extension portion 482 defining a recess 484 which in use receives a rib 486 of a reciprocating drive member 488. Thus, the reciprocating drive member 488 will cause the required pivoting motion of the blade 480, which in cooperation with a further cutting blade

490 may be used to cut through a cast material. Upon connection of the entire cutting mechanism or of at least the pivotally mounted blade 480, there may be a misalignment of the recess 484 with the rib 486, as shown in Figure 63. Thus, in one embodiment, the drive member 488 is arranged to be translated in the direction of arrow 492 (Figure 63), thus allowing the drive member 488 to "pick-up" the blade 480 by engagement of the rib 486 with the recess 484. This particular arrangement may be utilised in various forms of drive mechanism, such as those shown in Figures 58 to 61. In an alternative embodiment (not shown), the drive member 488 may be arranged to be "parked" in a set location, which would accommodate for replacing the blade 480 or entire cutting mechanism.

When a cast material is cut it has a natural tendency to splay slightly at the point of cut, as shown in Figure 64 which is a diagrammatic perspective view of a cast material 493 having a cut section 494, wherein the cut section has a splayed separation generally represented by numeral 496. In one embodiment of the present invention, shown in Figure 65, a protecting member or foot 498 is supported on a body (not shown) of a cast-cutter by use of a connecting member 500 which is formed to fit within the natural splay 496 of a cast

material being cut. In the embodiment shown, the connecting member is generally wedge shaped. This wedge shape may additionally assist in separation of the cut edges 502, 504 of the material to assist in preventing the cutting blade or blades (not shown) from becoming snagged in the cast material.

Reference is now made to Figures 66, 67 and 68 in which there is shown a cast-cutter 506 in accordance with an embodiment of the present invention, wherein the cast-cutter includes a cutting assembly 508 mounted on a body 510. In this embodiment, the cutting assembly 508 may be removed from the body 510, as shown in Figure 67, and subsequently reattached to the body 510 in a reverse direction, as shown in Figure 68. The cutting assembly 508 may be secured to the body 510 in any suitable manner, such as my a locking engagement, a screw or bolting arrangement, a pin arrangement, magnets or the like. This particular arrangement allows the cast-cutter to be operated in at least two directions of cut. Additionally, providing a cutting assembly 508 which is removable from the body 510 allows a used assembly the be removed and replaced with a new, sterile or clean assembly, thus minimising the risk of transmitting infection between patients. The arrangement may be such that different types of cutting assembly be reattached in

accordance with the type or size of cast to be removed. Furthermore, it may be possible to change a particular cutting assembly for one which, for example, preferentially cuts a curve in a particular direction.

An alternative embodiment of a cast-cutter 512 is shown in Figures 69 and 70, wherein Figure 70 is a cross-sectional view of the cast-cutter of Figure 69, taken along line 70-70. The cast-cutter includes a body 514 upon which is mounted two diametrically opposed cutting assemblies 516, 518. The cast-cutter 512 further includes a safety guard 520 which may be fitted over the appropriate cutting assembly which is not in use, which in the embodiment shown is assembly 518.

Various embodiments of "linear action" cutting means for use with a cast-cutter in accordance with the present invention will now be described with reference to Figures 71 to 76.

Reference is first made to Figures 71 and 72; Figure 71 is a side view of a cutting means 522 of a cast-cutter, and Figure 72 is a cross-sectional view of the cutting means 522 taken through line 72-72 of Figure 70. The cutting means 522 includes a first cutting member 524 mounted on a connecting member 526 (not shown in Figure 72 for clarity) and a second cutting member 528 mounted for reciprocating motion in the direction of arrow 530.

The second cutting member 528 is slidably mounted within a sleeve 532 which includes diagonally opposed locator ribs 534, 536 which act together to ensure a positive pressure between the cutting members 524, 528 to ensure an optimum cutting operation. Although not shown, this arrangement may additionally include a force storage device to further assist in achieving a positive pressure between the cutting members 524, 528.

A variation of the embodiment shown in Figures 71 and 72 is shown in Figure 73, wherein a dual action cutting means 538 is provided which includes back-to-back cutting members 540 and sleeves 542 similar to the cutting member 528 of Figures 71 and 72. This embodiment allows the cast-cutter to be readily operated in reverse directions.

A further alternative embodiment is shown in Figures 74 and 75, wherein Figure 75 is a cross-sectional view through line 75-75 of Figure 74. In this embodiment a first cutting member 544 is provided which is attached to a support member 546, which support member 546 is attached to a sleeve 548. The support member 546 is not shown in Figure 74 for clarity. A second cutting member 550 is provided which is arranged to reciprocate in the direction of arrow 552, wherein the second cutting member 550 defines a slot 554 adapted to accommodate the support

member 546. The second cutting member 550 is slidably mounted within the sleeve 548, which is similar to sleeve 532 of Figures 71 and 72, and as such no further description will be given.

Reference is now made to Figure 76 which shows a cutting means 556 similar to that shown in Figures 74 and 75, with the exception that the first and second cutting members 558, 560 are adapted to be used to cut in opposing directions.

A number of alternative embodiments have been described above in accordance with aspects of the present invention. It should be appreciated that these various embodiments may be used in various combinations and are not limited for use as specifically shown and described.

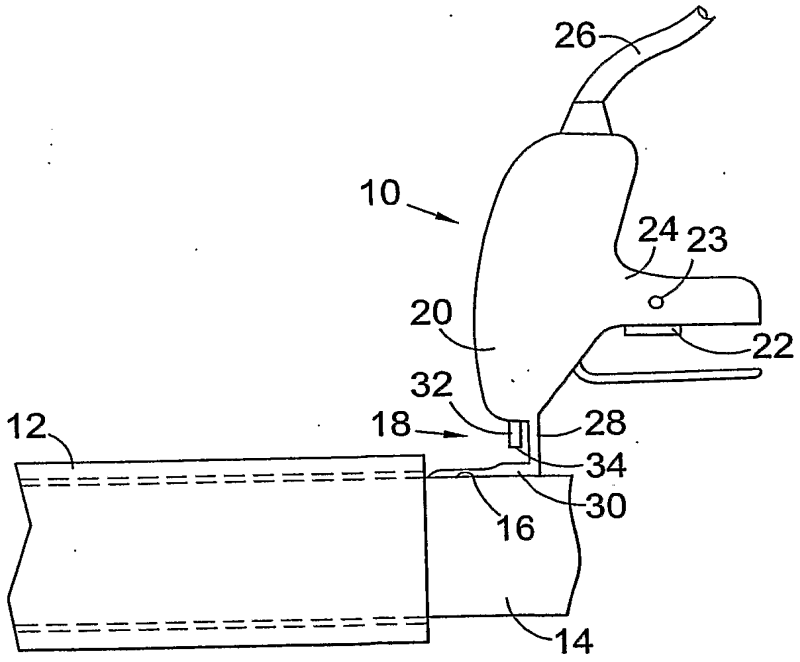


Fig. 1

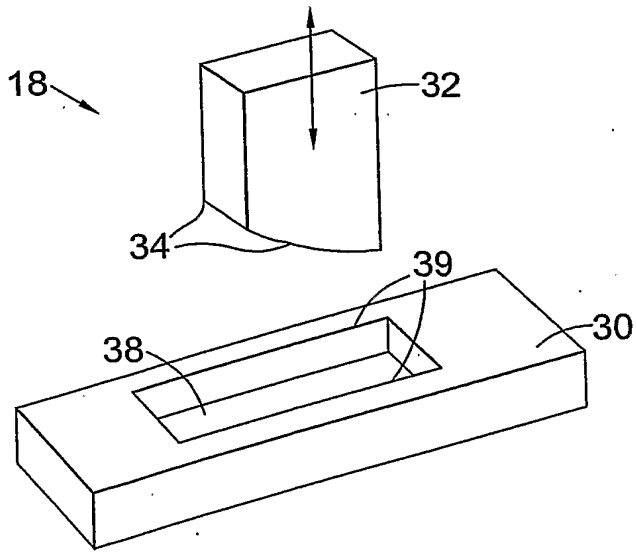


Fig. 2

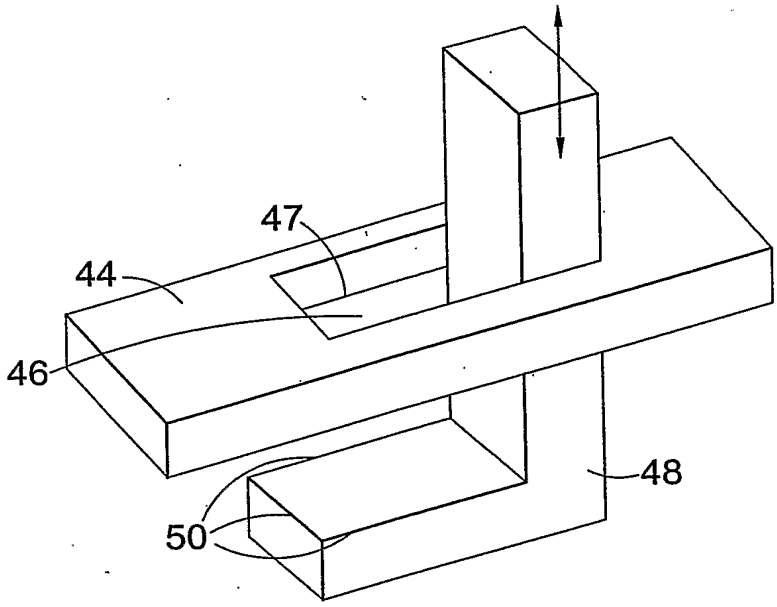


Fig. 3

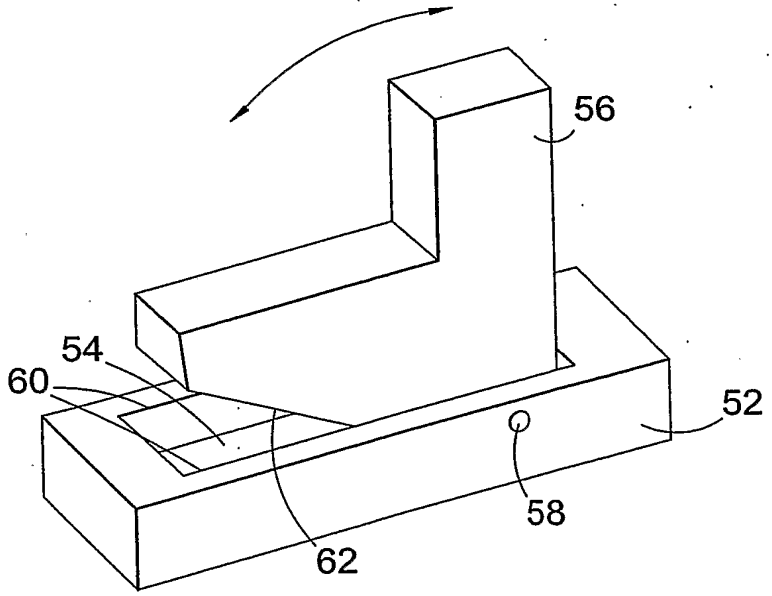


Fig. 4

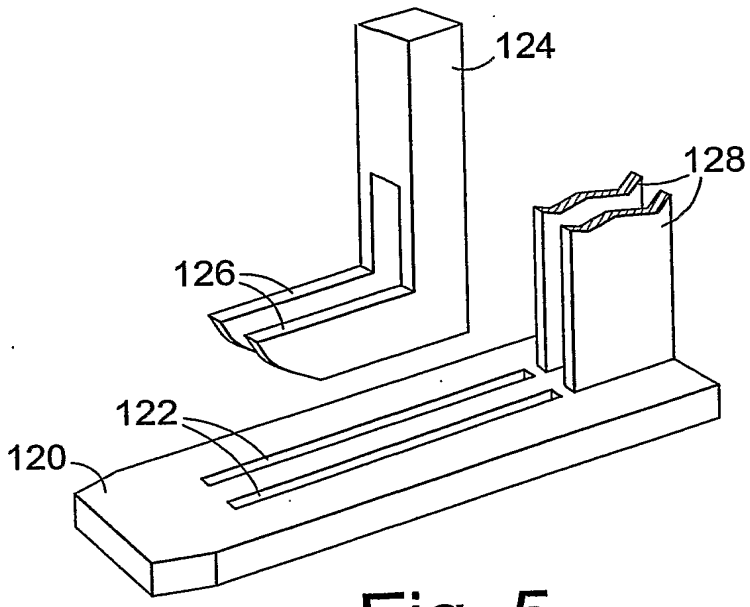


Fig. 5

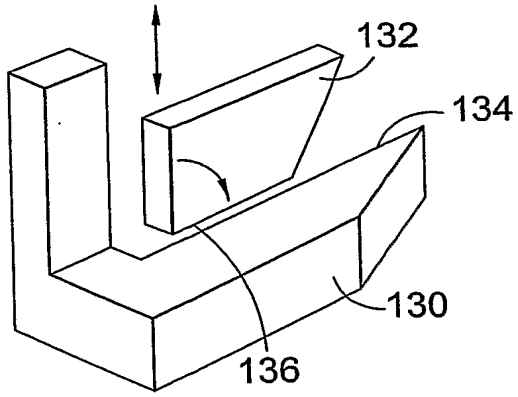


Fig. 6

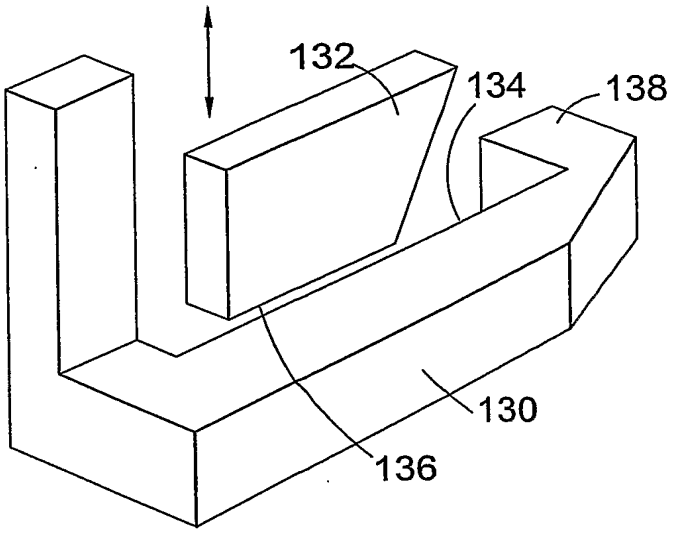
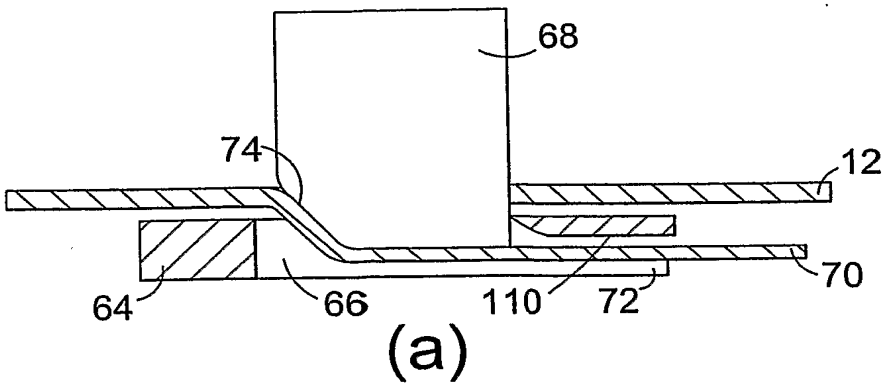
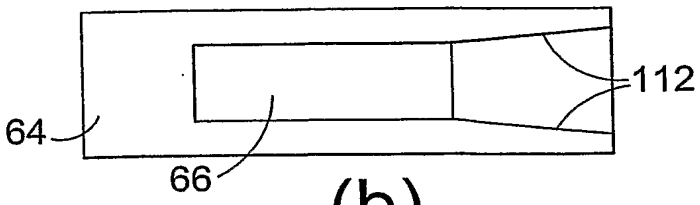


Fig. 7



(a)



(b)

Fig. 8

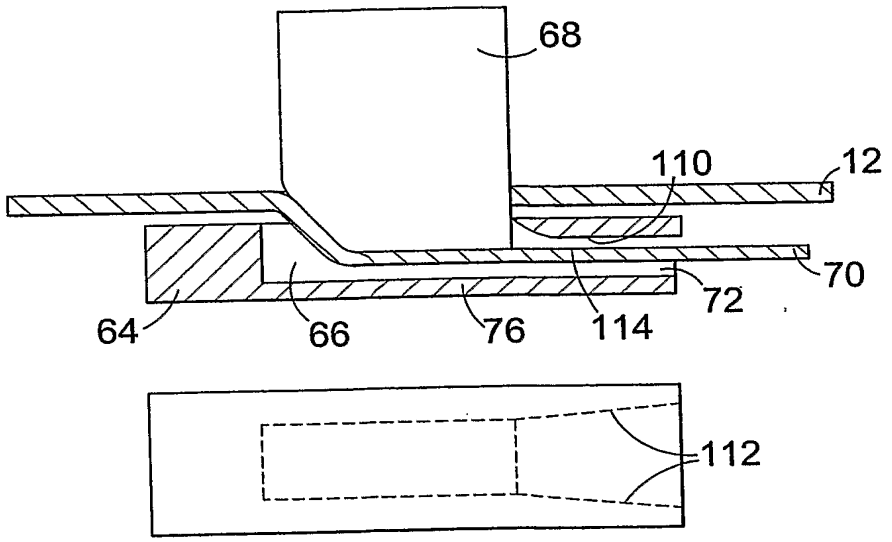


Fig. 9

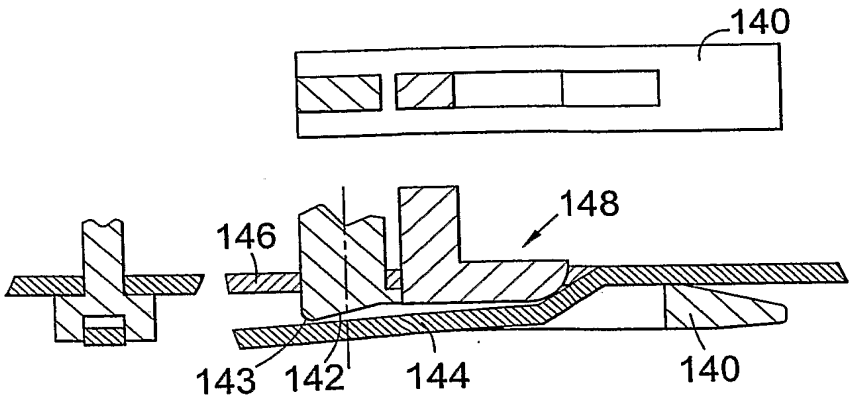


Fig. 10

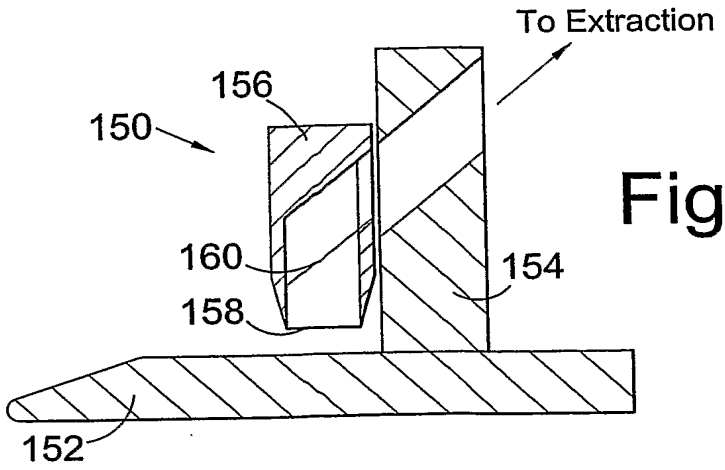


Fig. 11

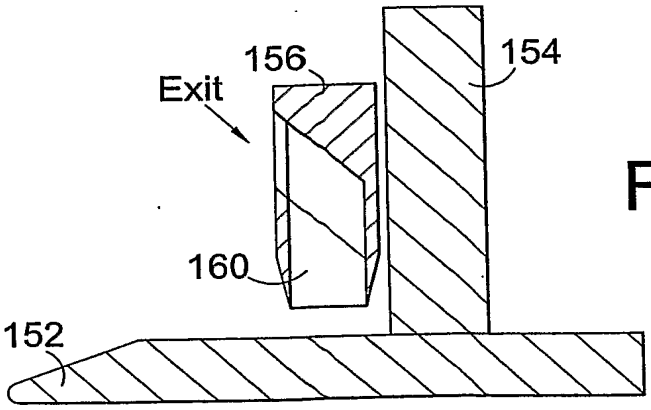


Fig. 12

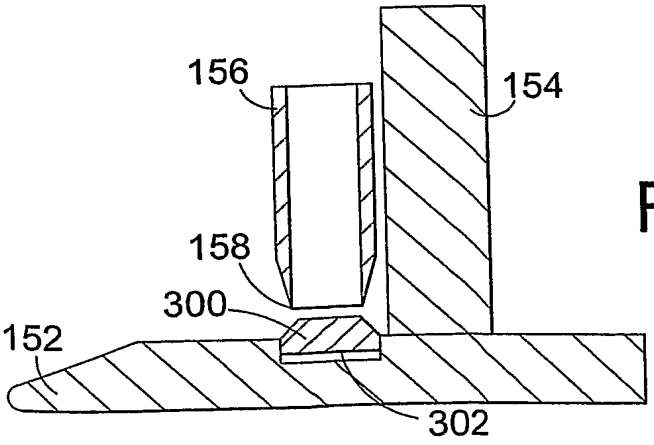


Fig. 13

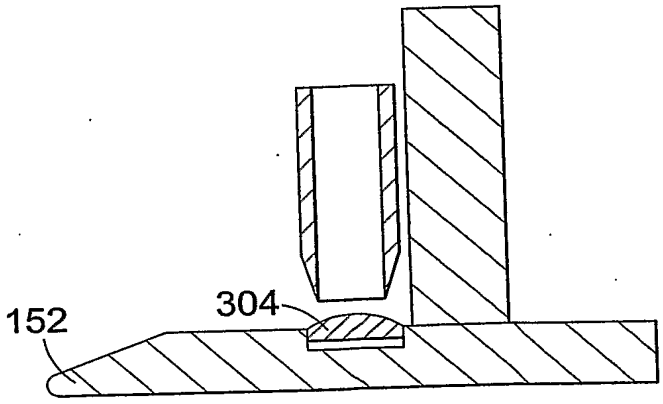


Fig. 14

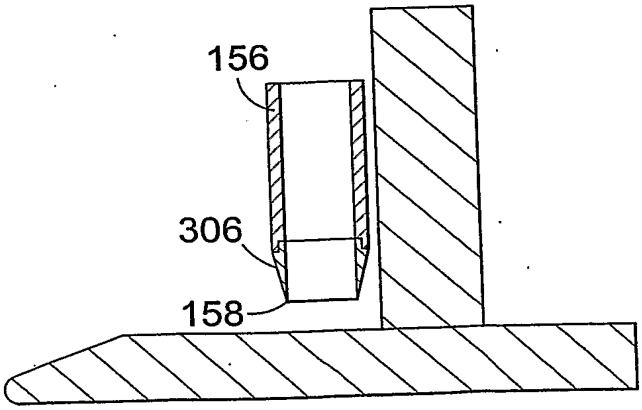


Fig. 15

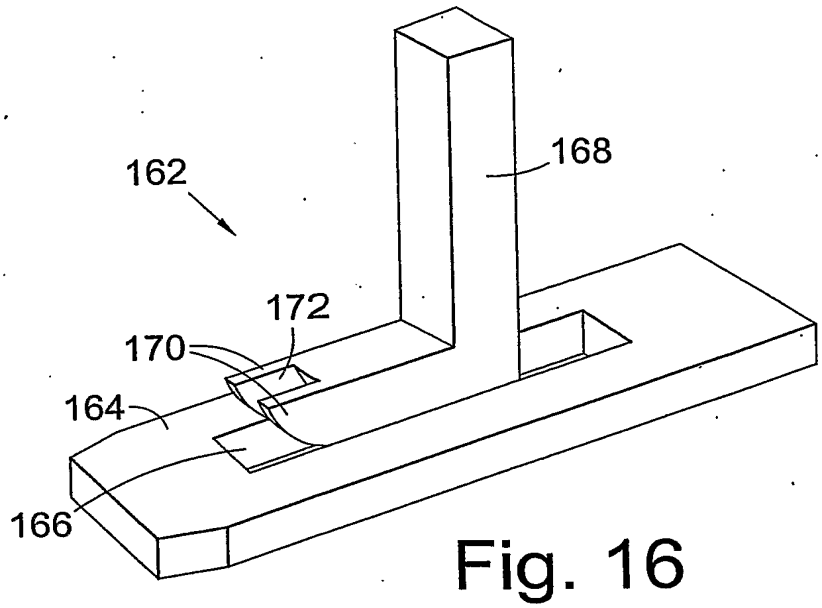


Fig. 16

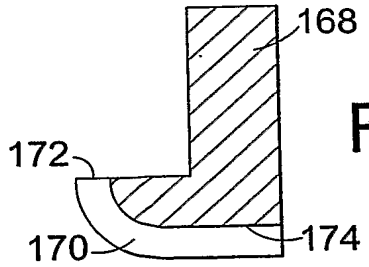


Fig. 17

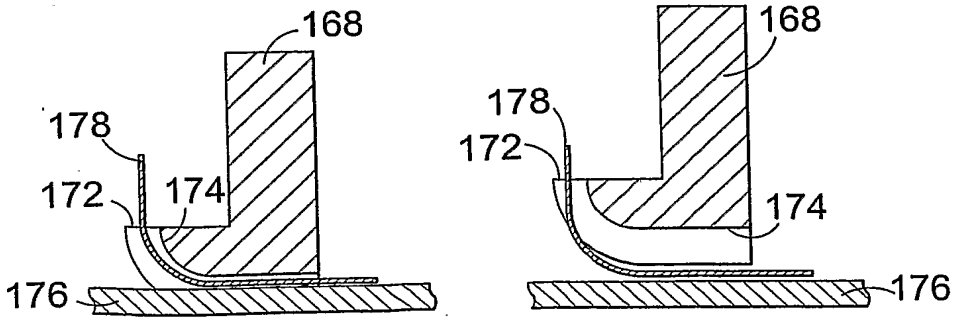


Fig. 18

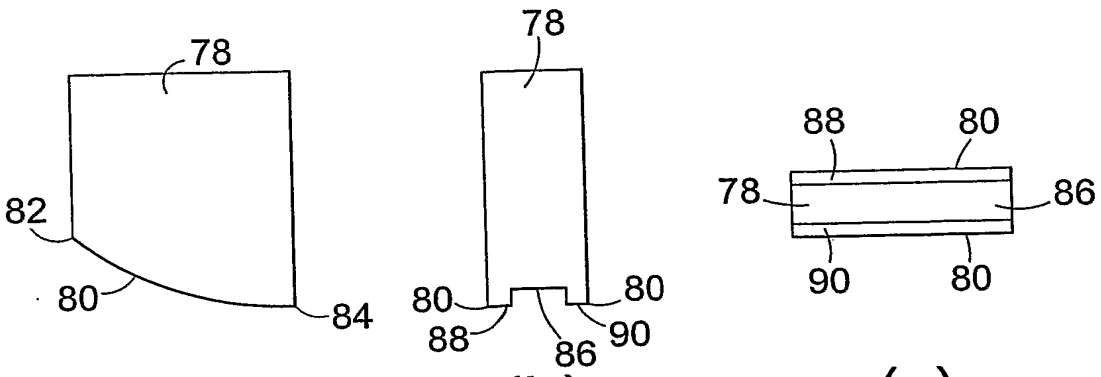


Fig. 19

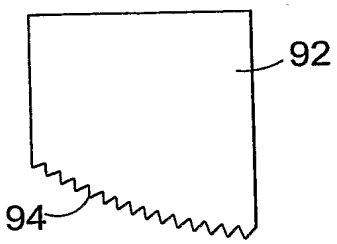


Fig. 20

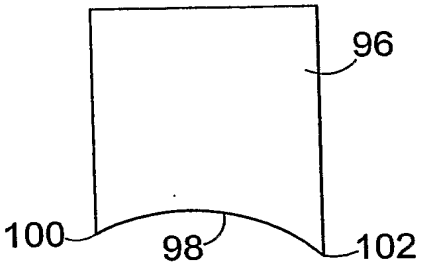


Fig. 21

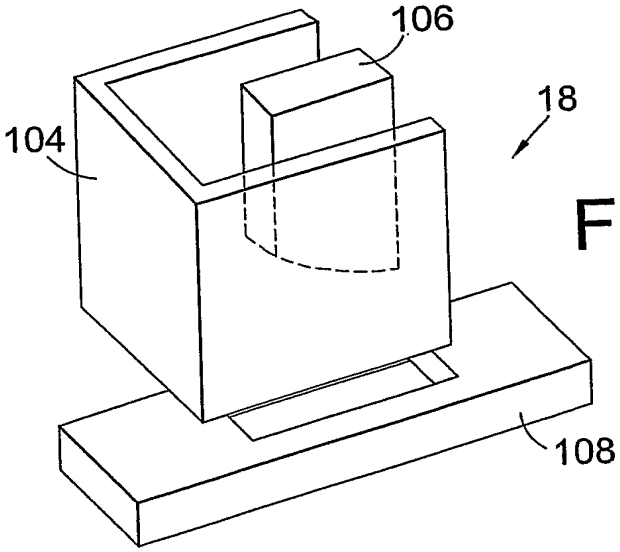


Fig. 22

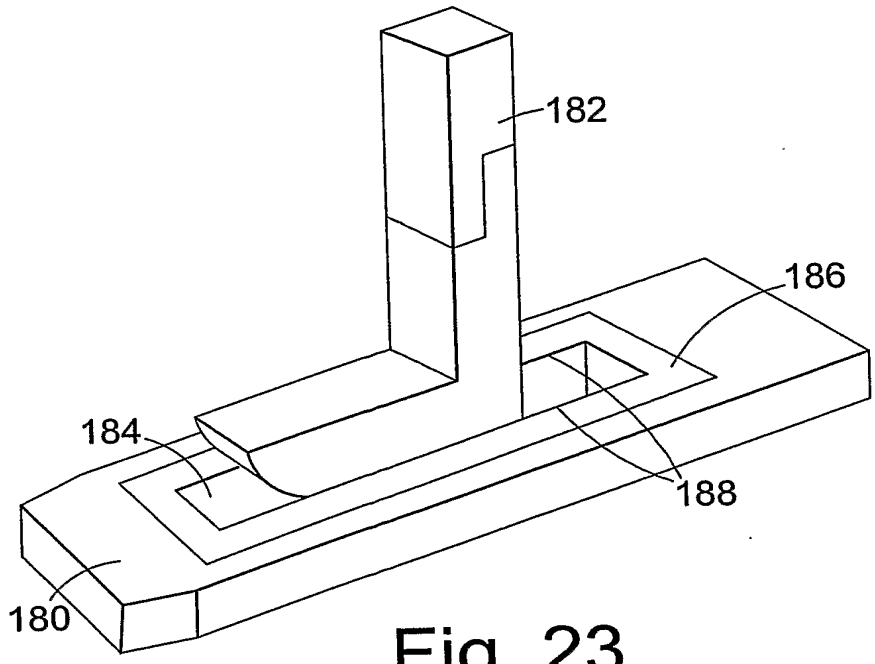


Fig. 23

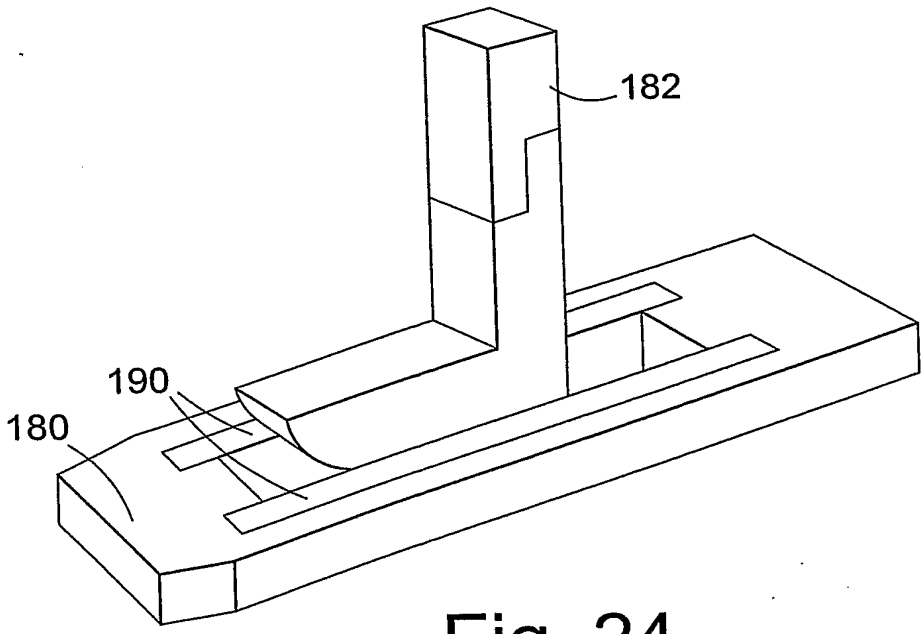


Fig. 24

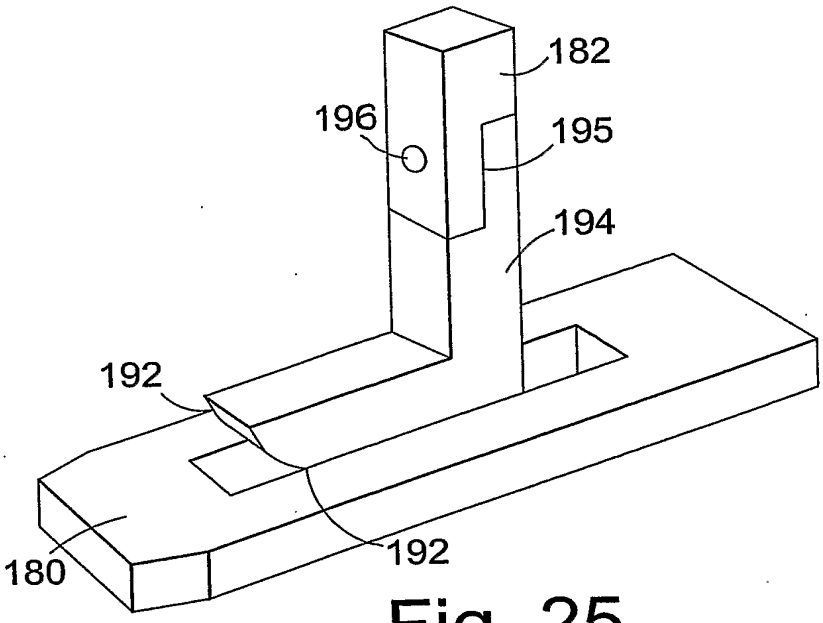


Fig. 25

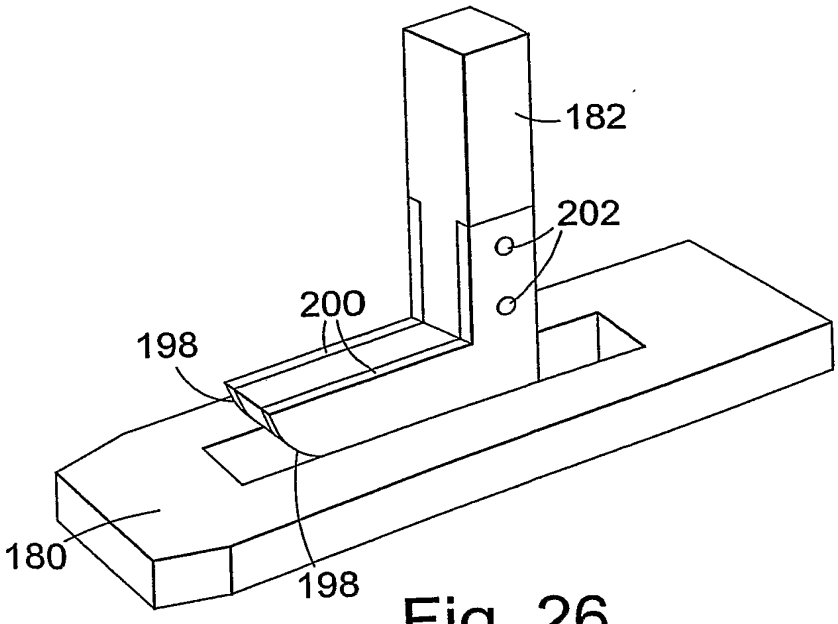


Fig. 26

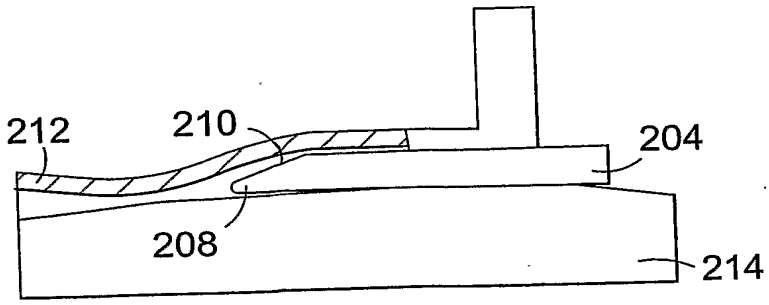


Fig. 27

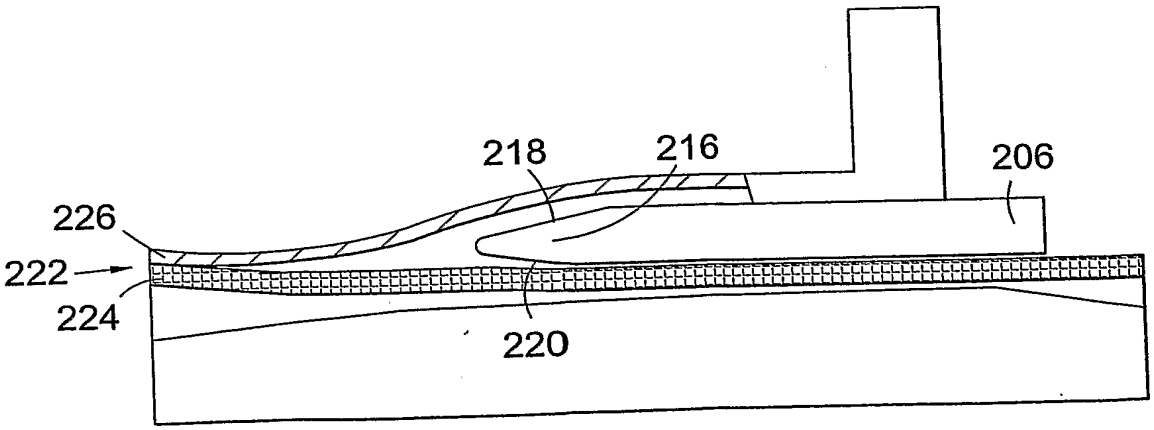


Fig. 28

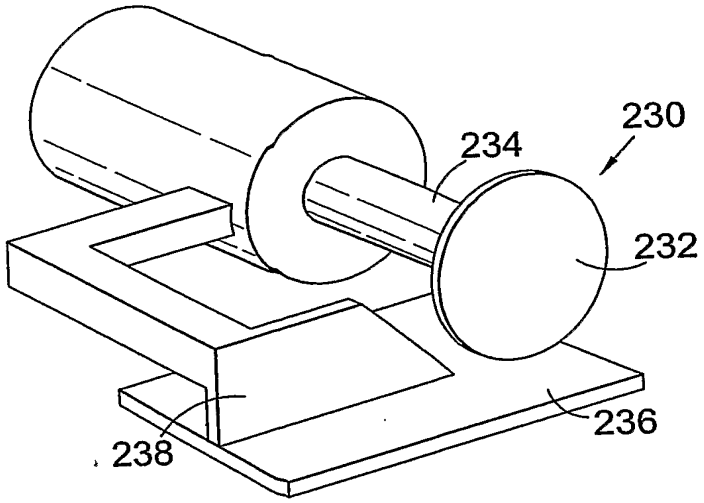


Fig. 29

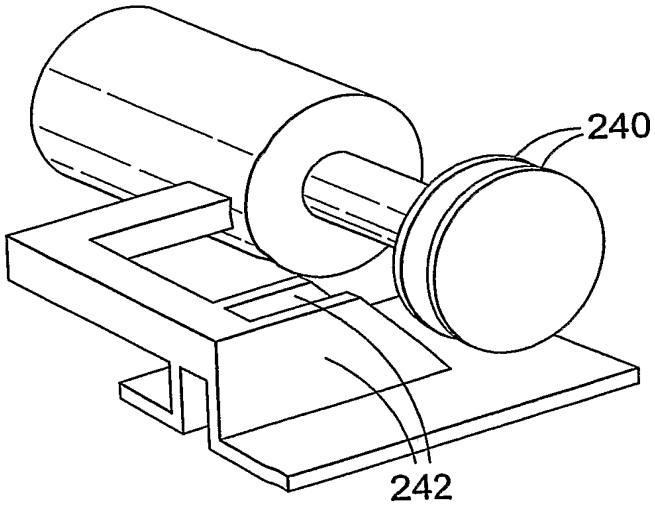


Fig. 30

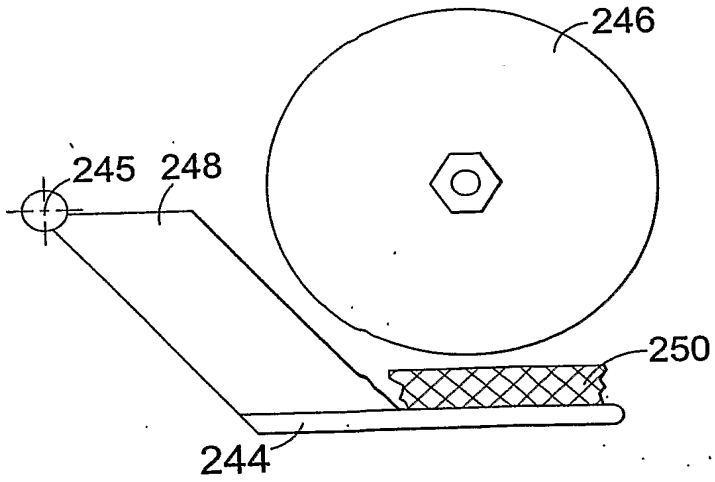


Fig. 31

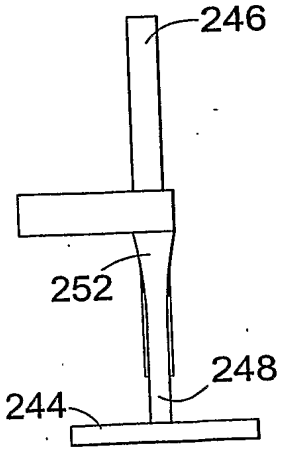


Fig. 32

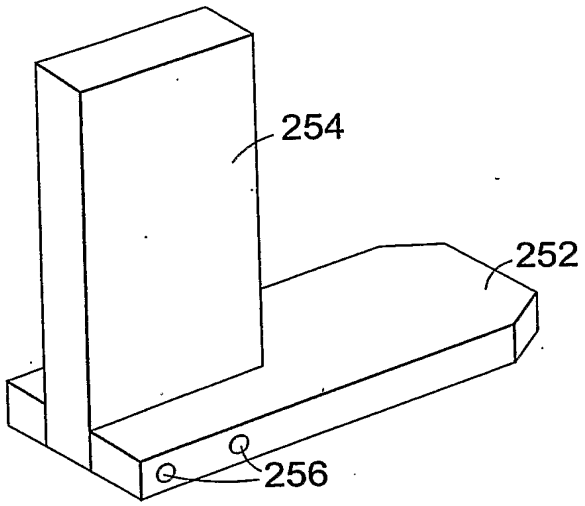


Fig. 33

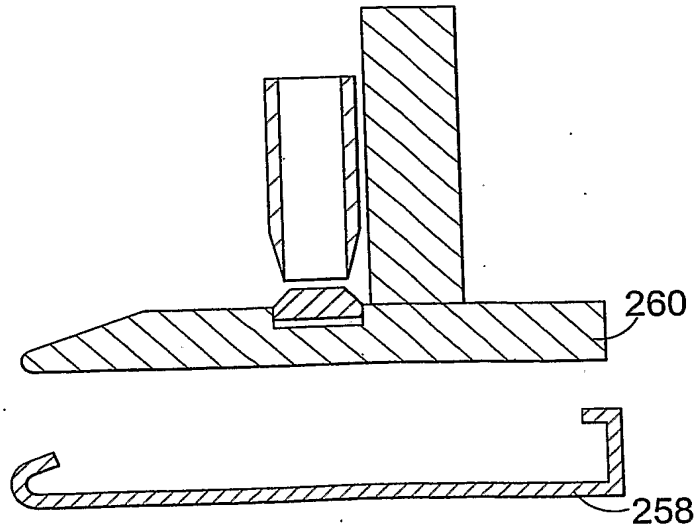


Fig. 34

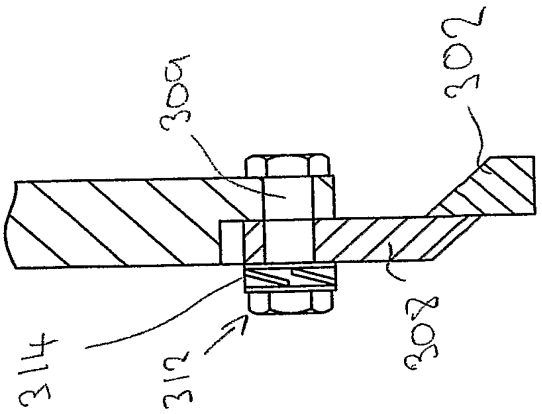


Fig 36

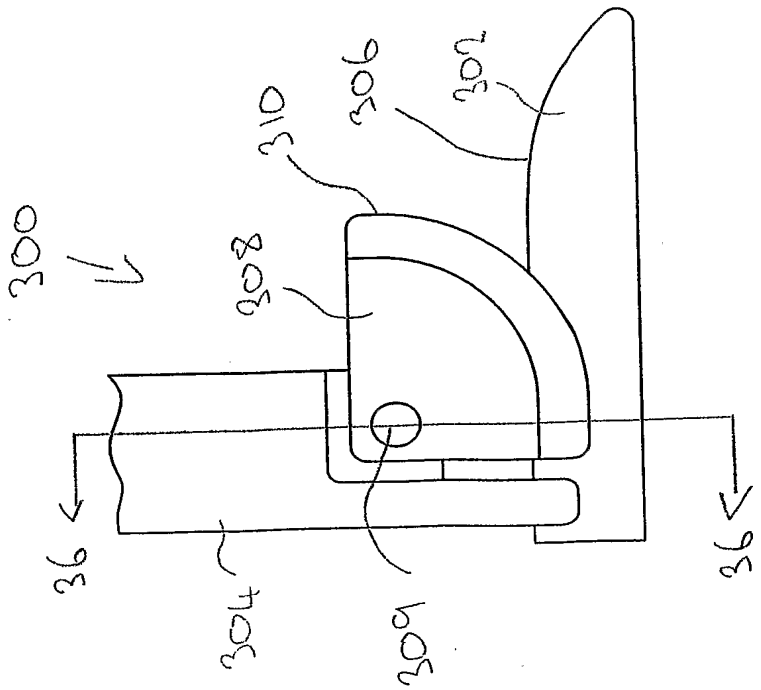


Fig 35

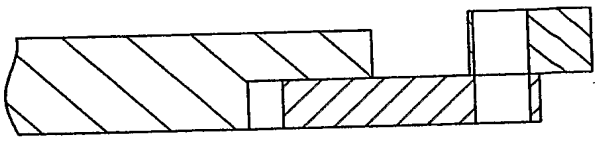


Fig 36

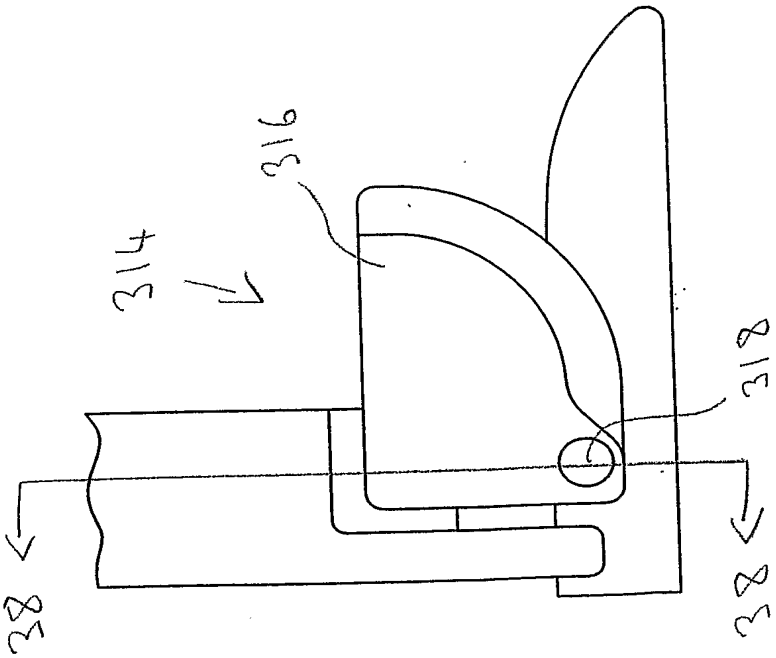


Fig 37

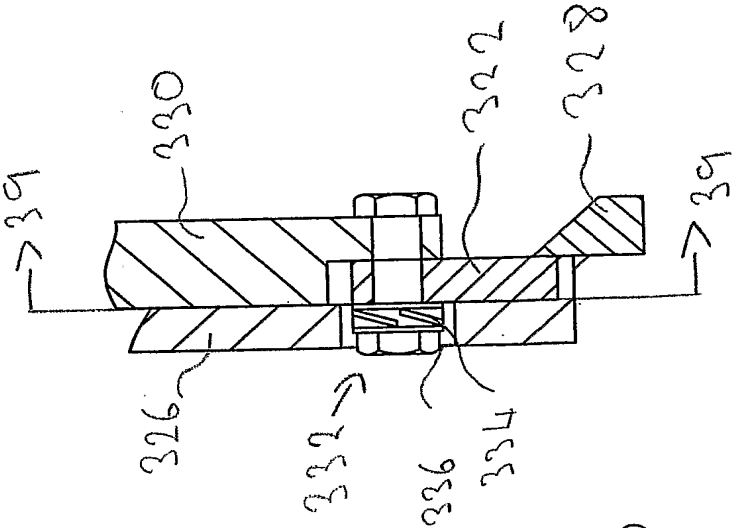


Fig 40

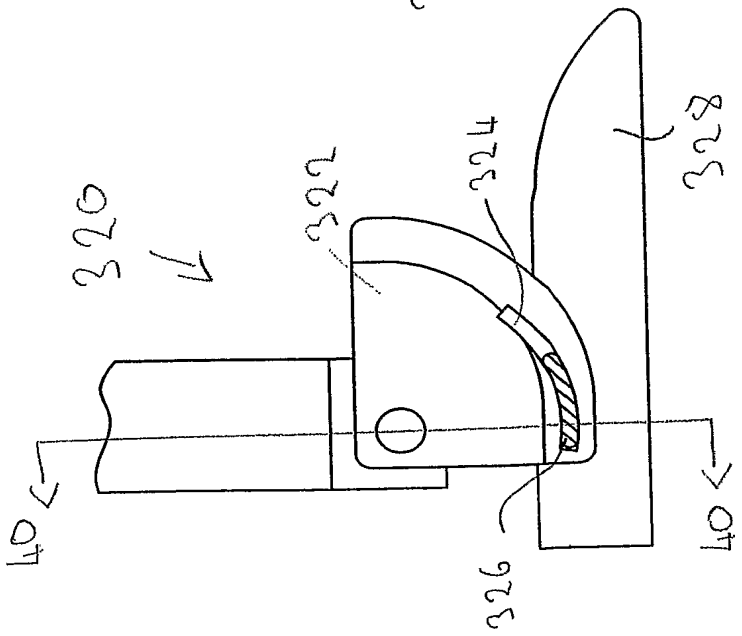


Fig 39

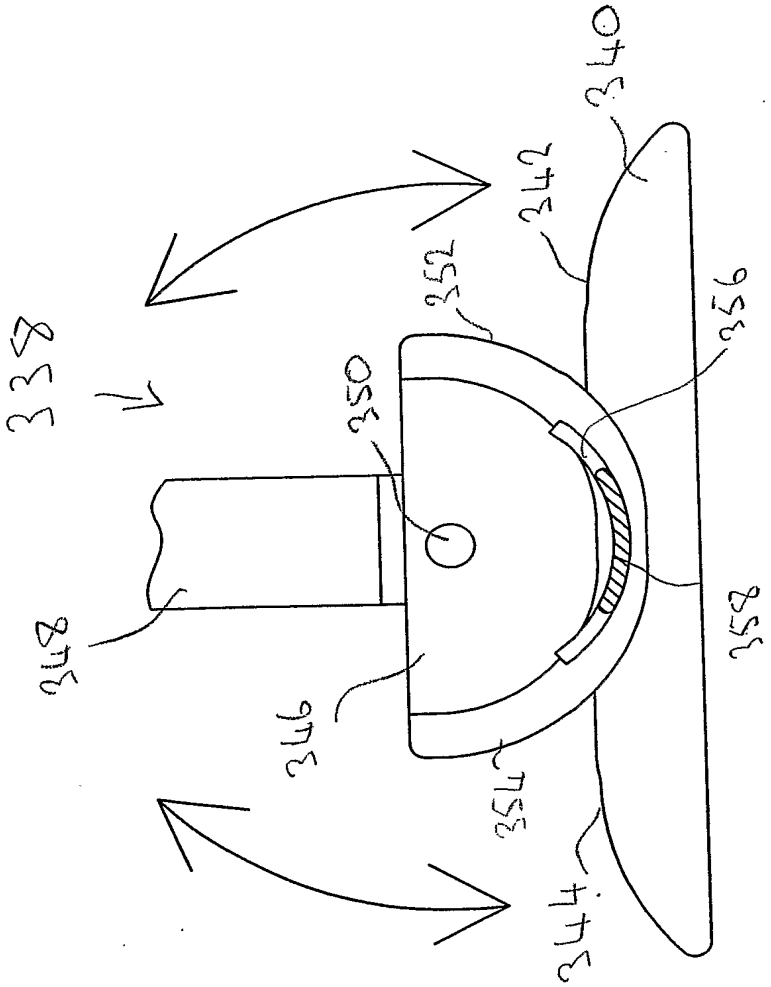


Fig 41

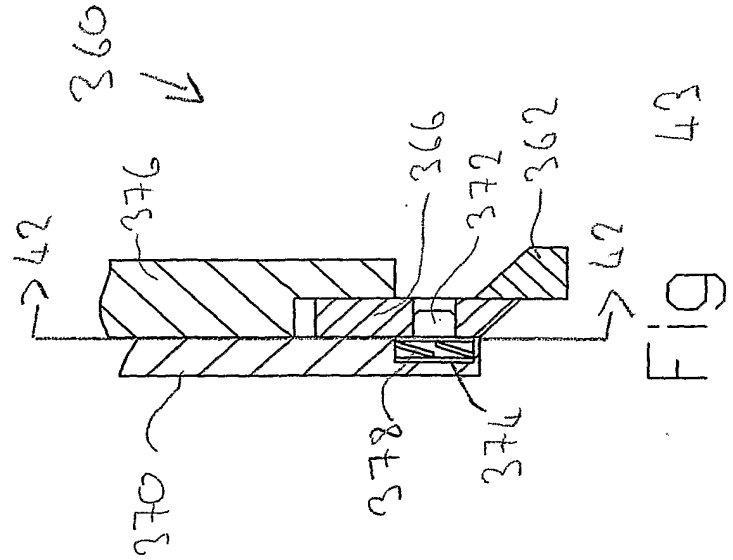


Fig 43

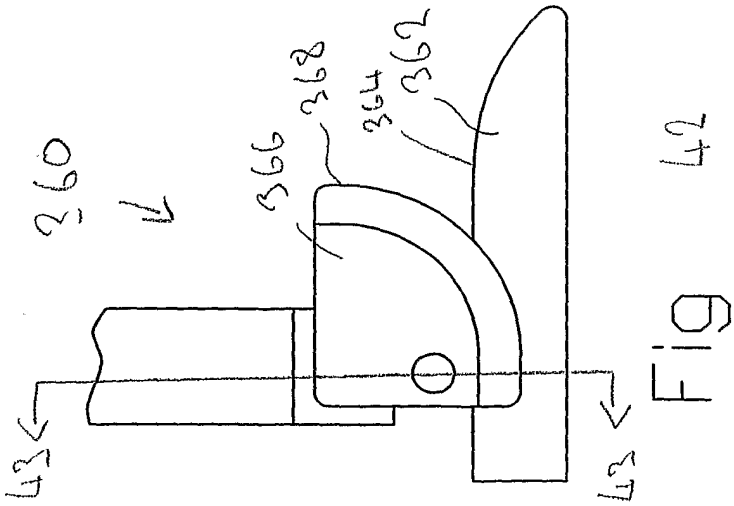


Fig 42

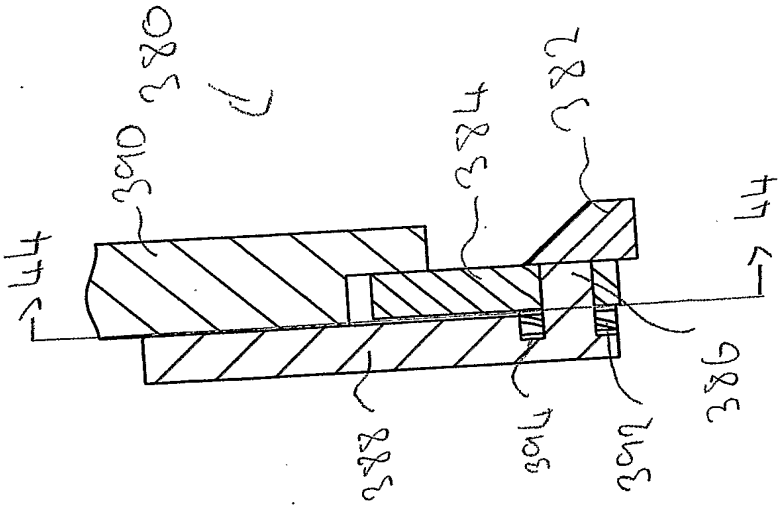


FIG 45

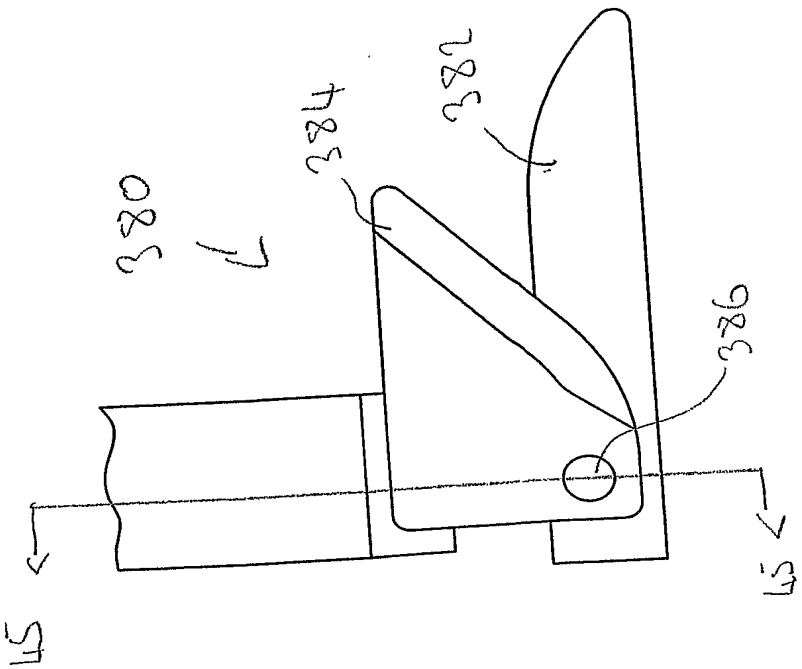


FIG 44

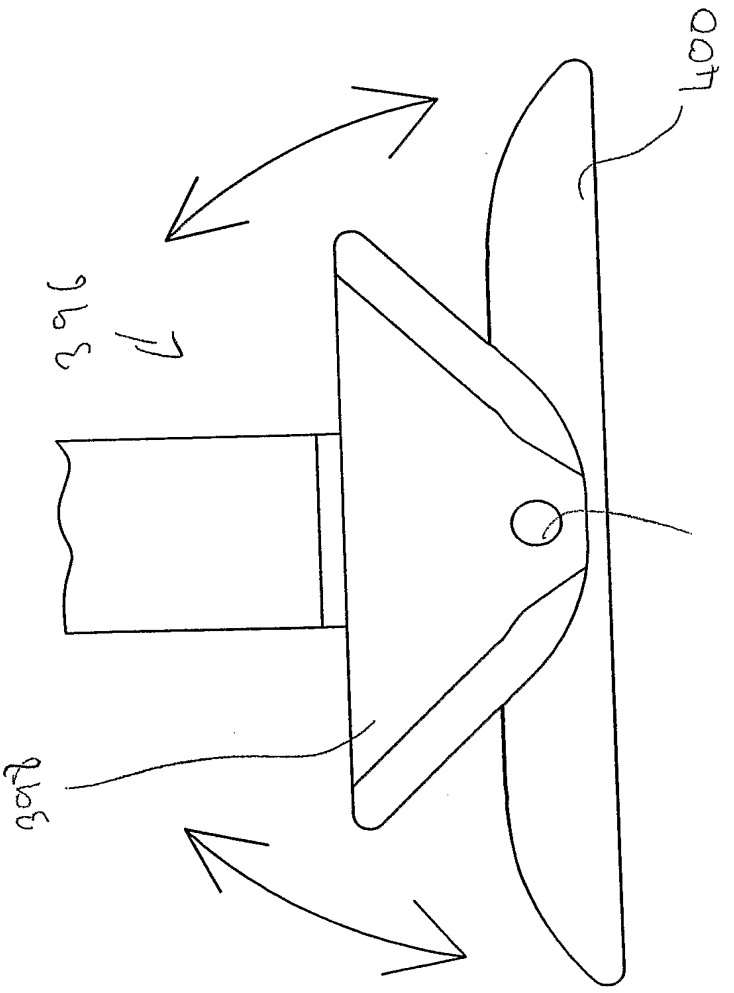


Fig 46

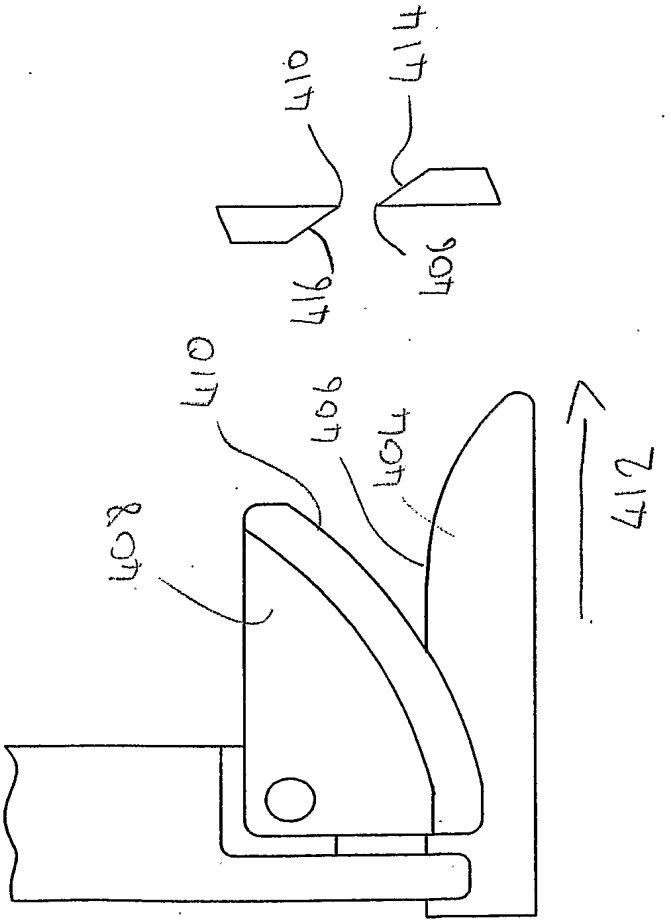


Fig 48

Fig 47

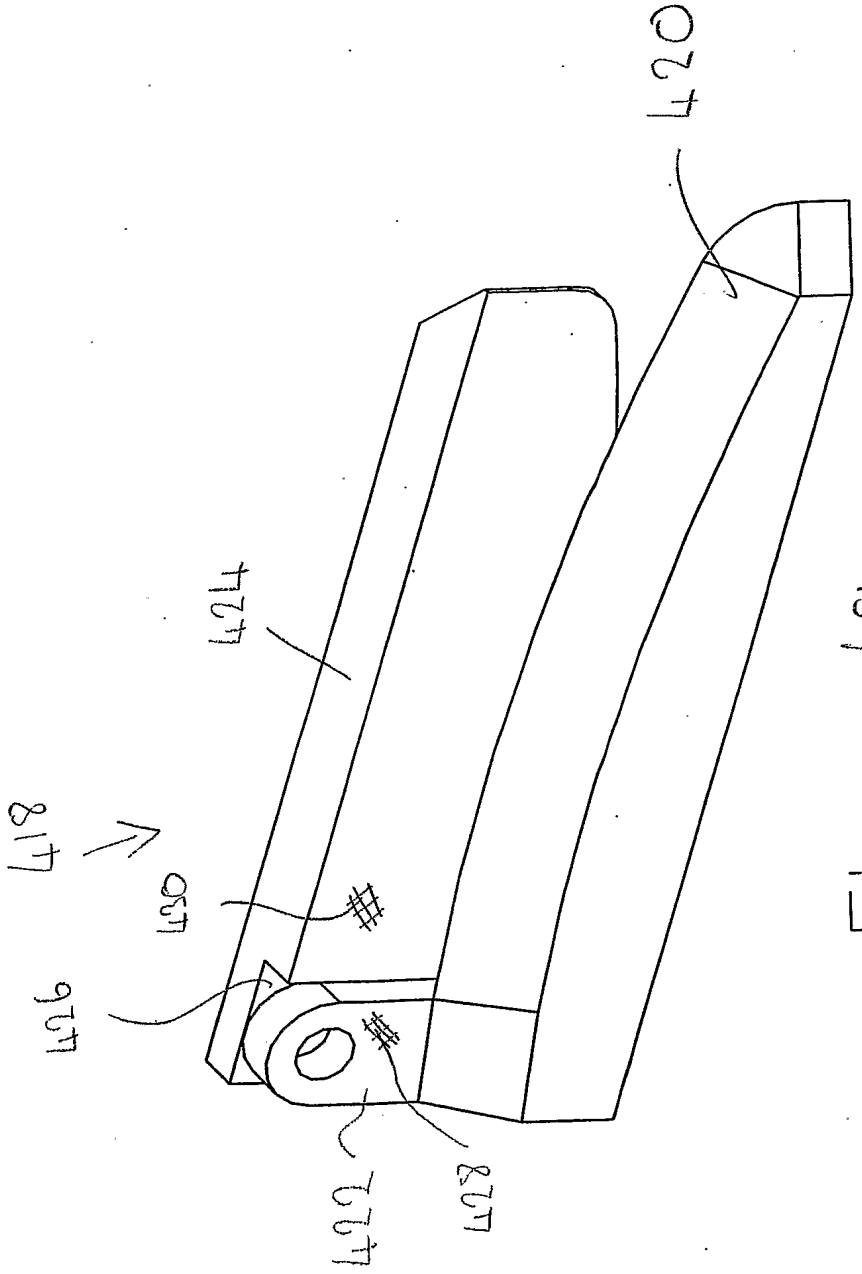


Fig 4

Fig 50

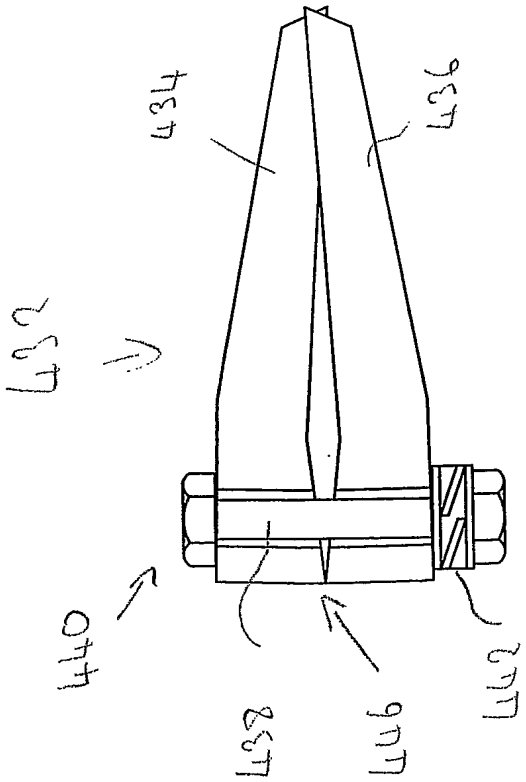


Fig 51

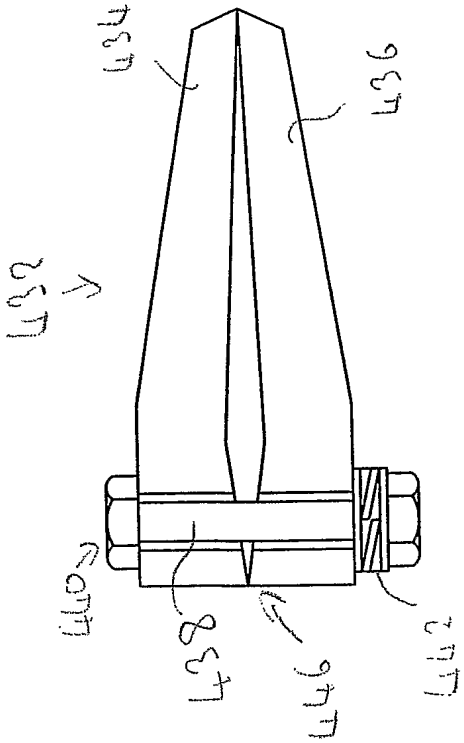


Fig 52

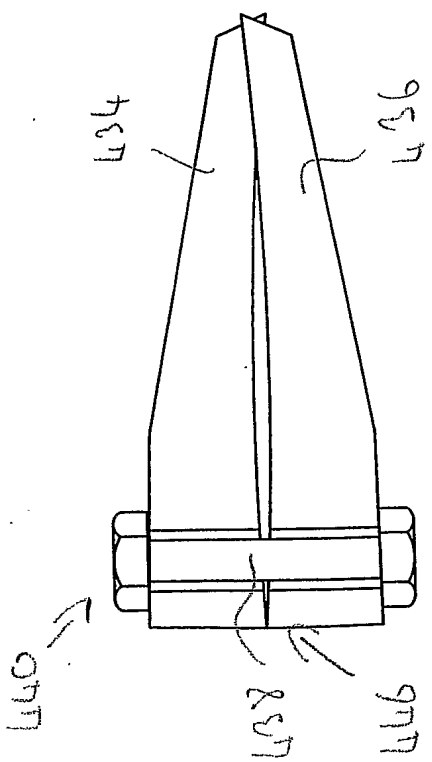
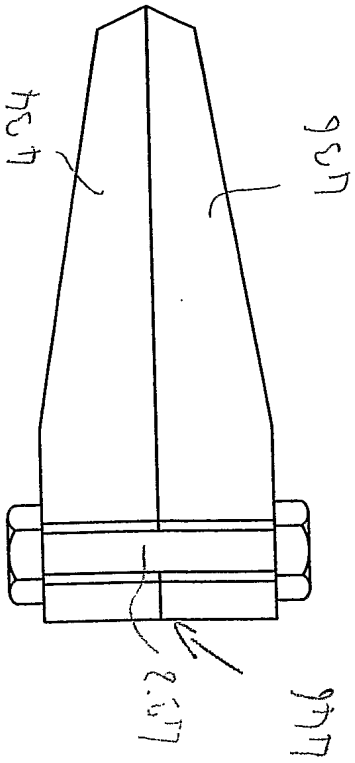


Fig 53



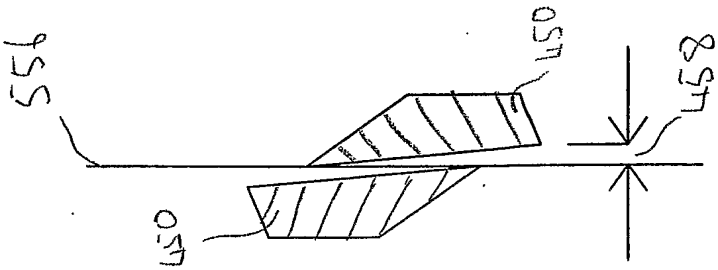


Fig 54

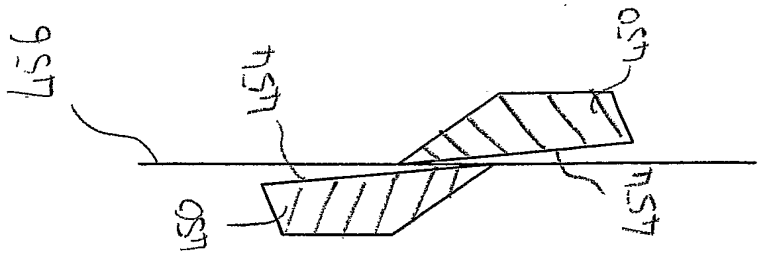


Fig 56

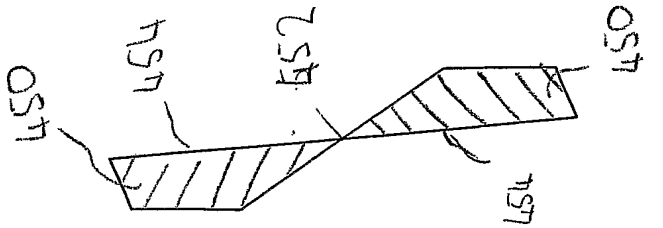


Fig 55

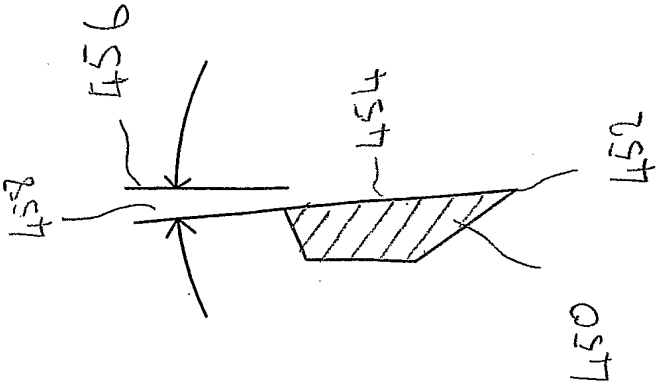


Fig 54

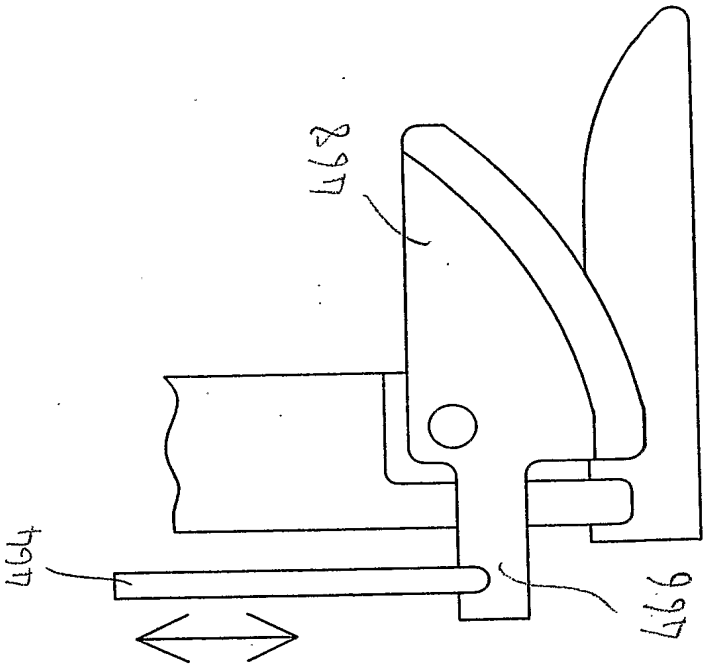


Fig 5A

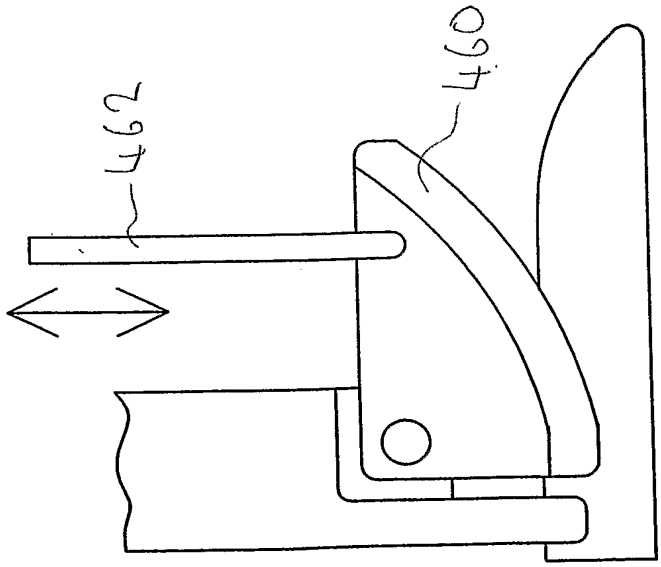


Fig 5B

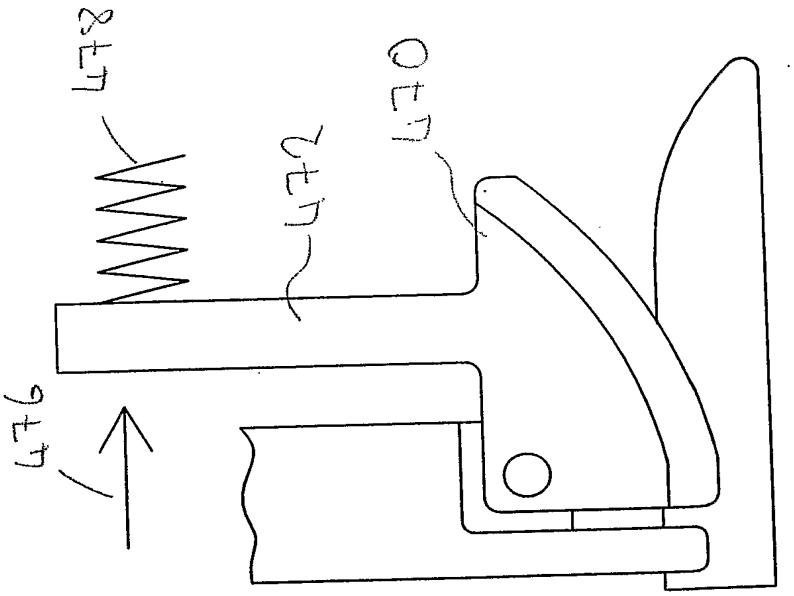


Fig 61

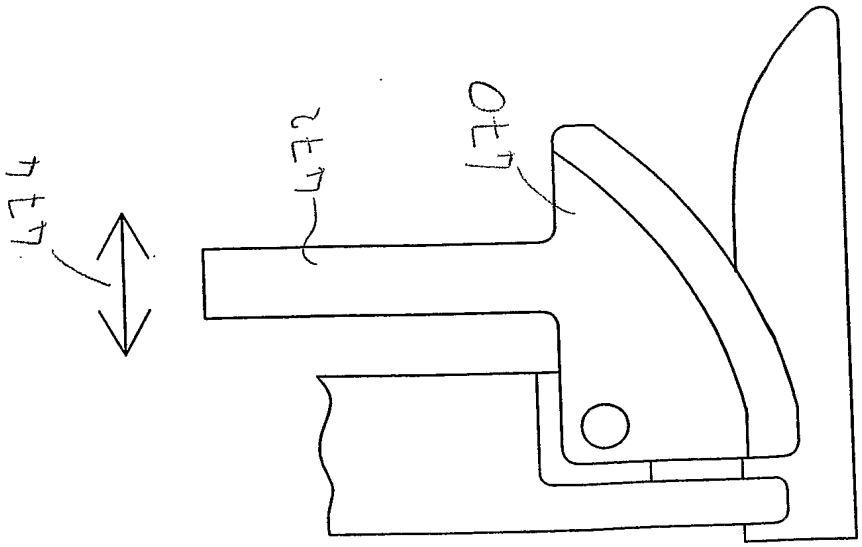


Fig 60

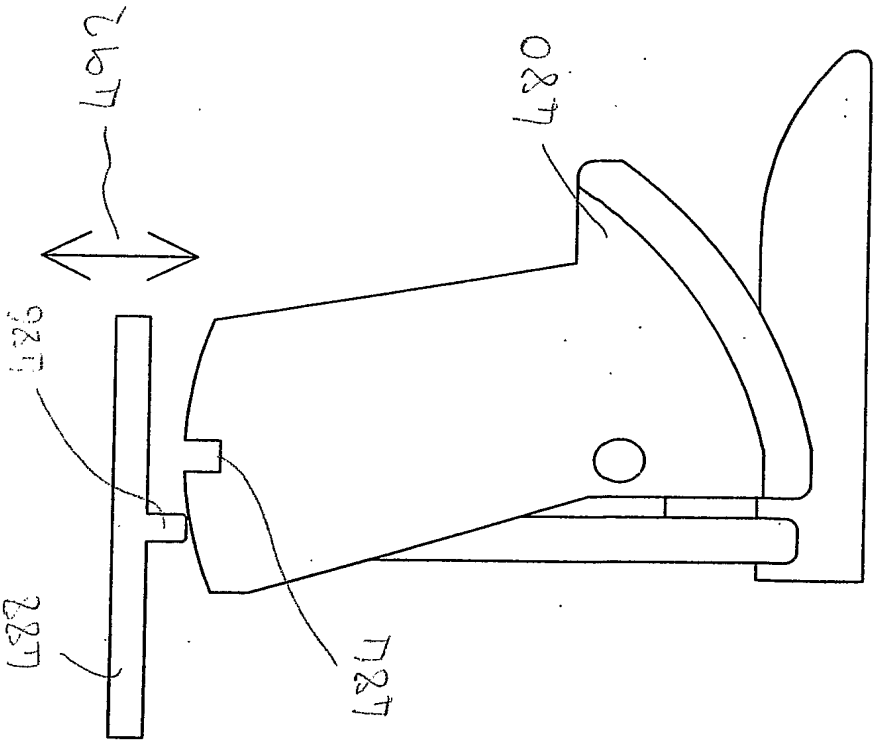


Fig 6J

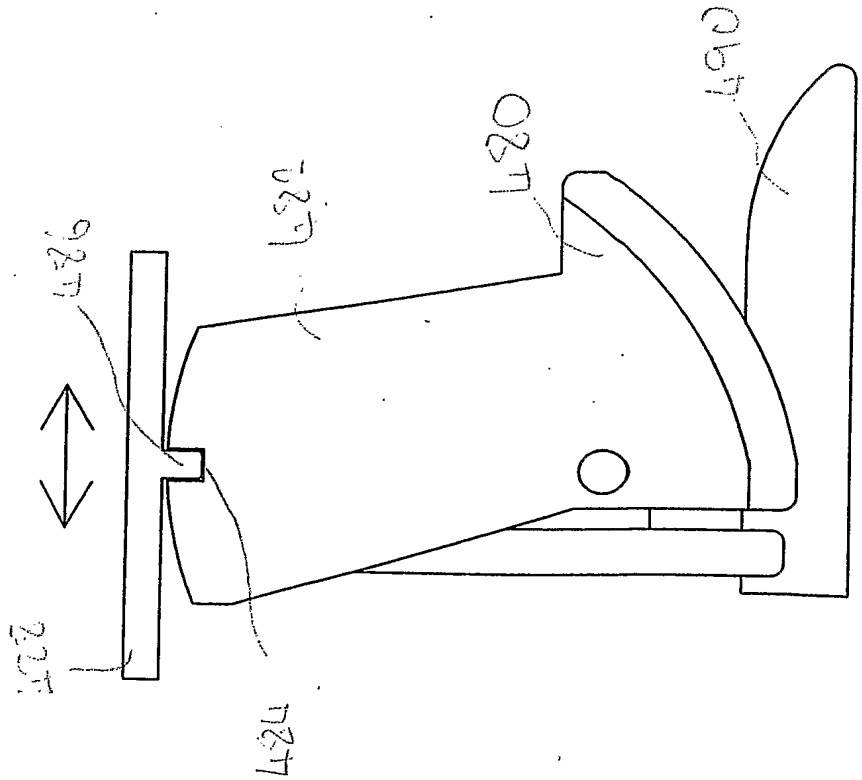


Fig 6K

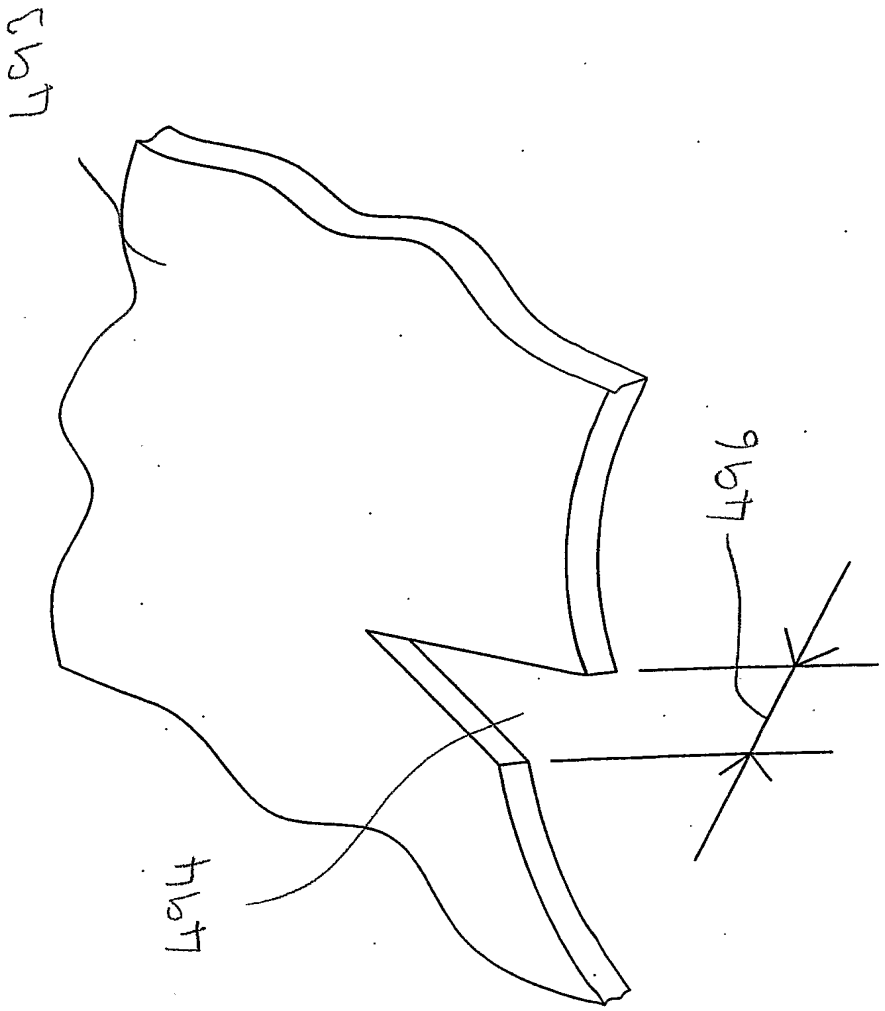


Fig 64

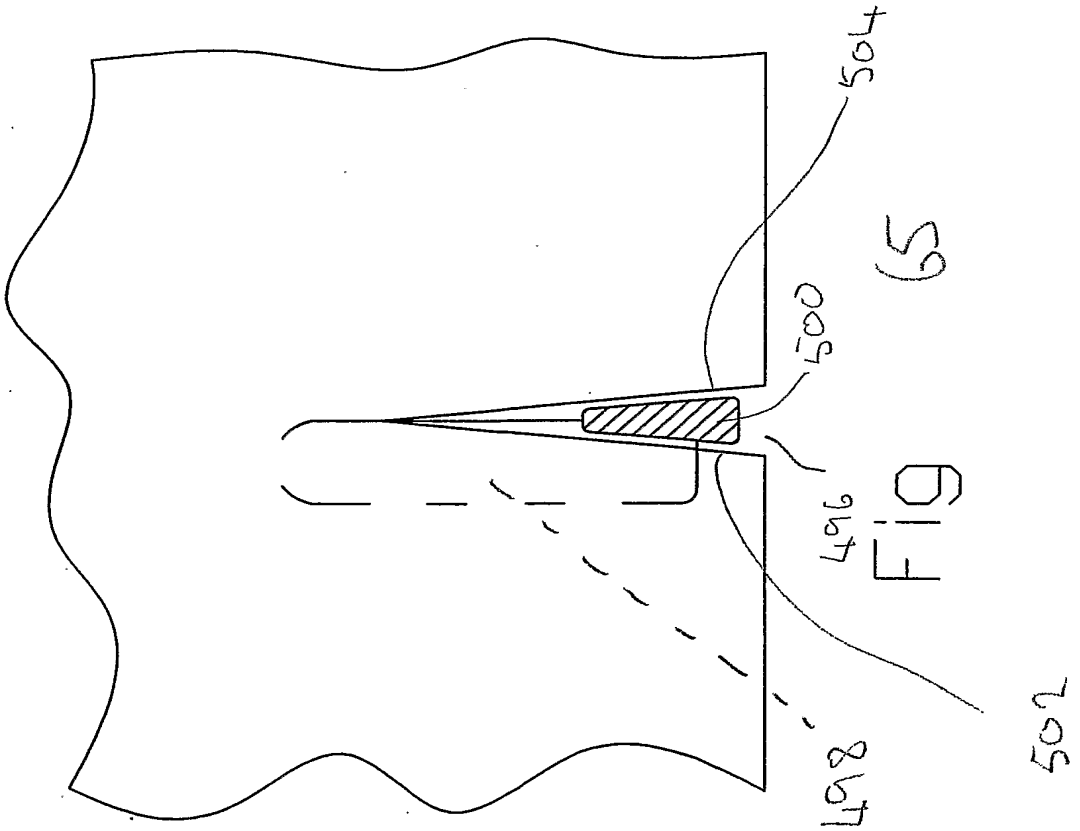


Fig 65

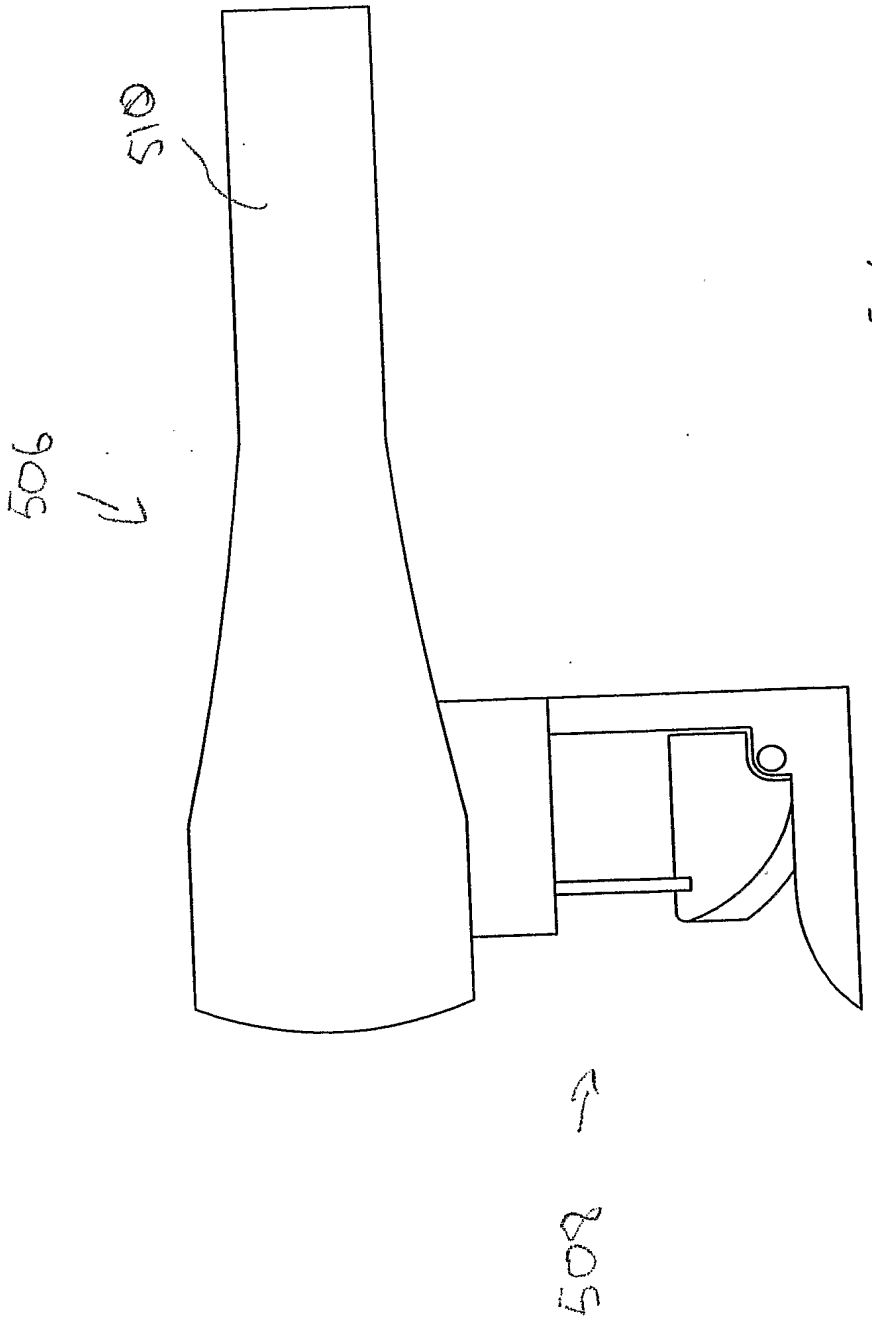


Fig 66

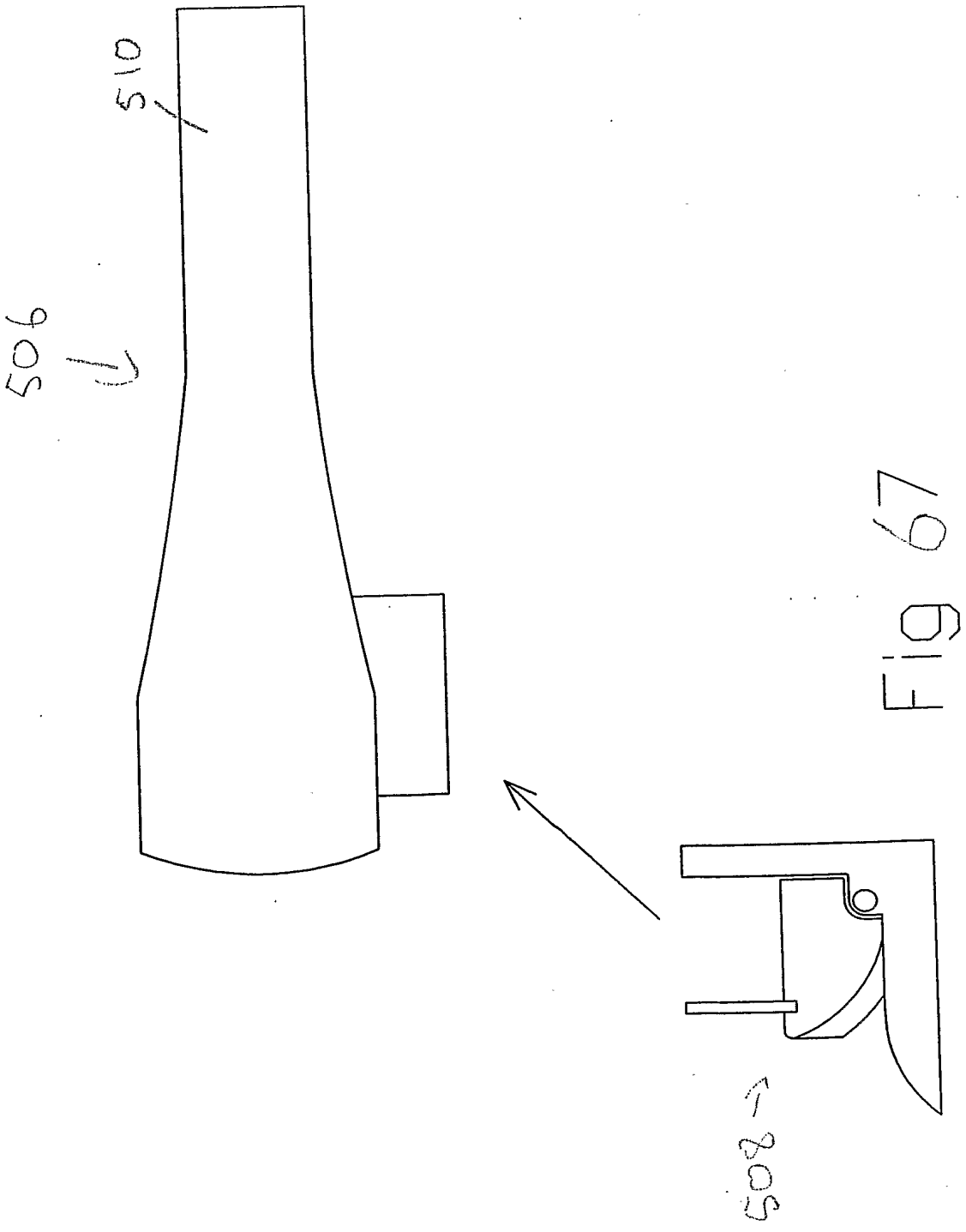


Fig 67

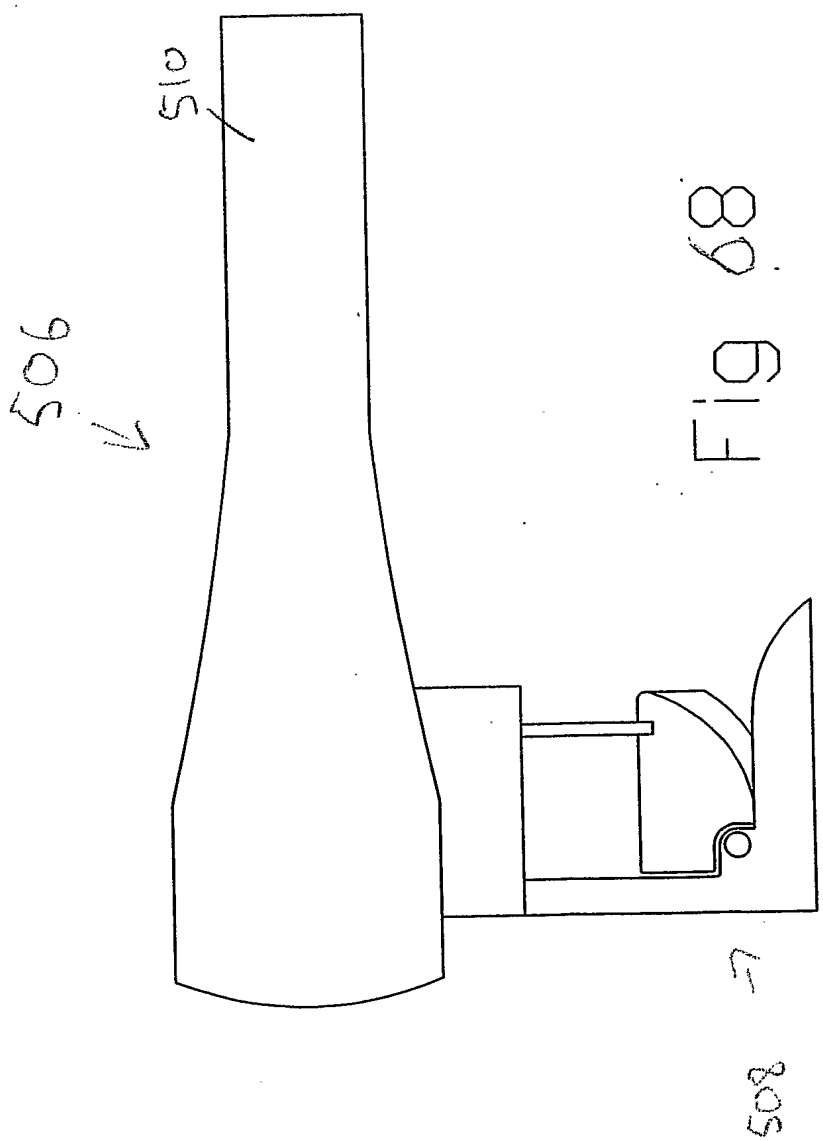


Fig 68.

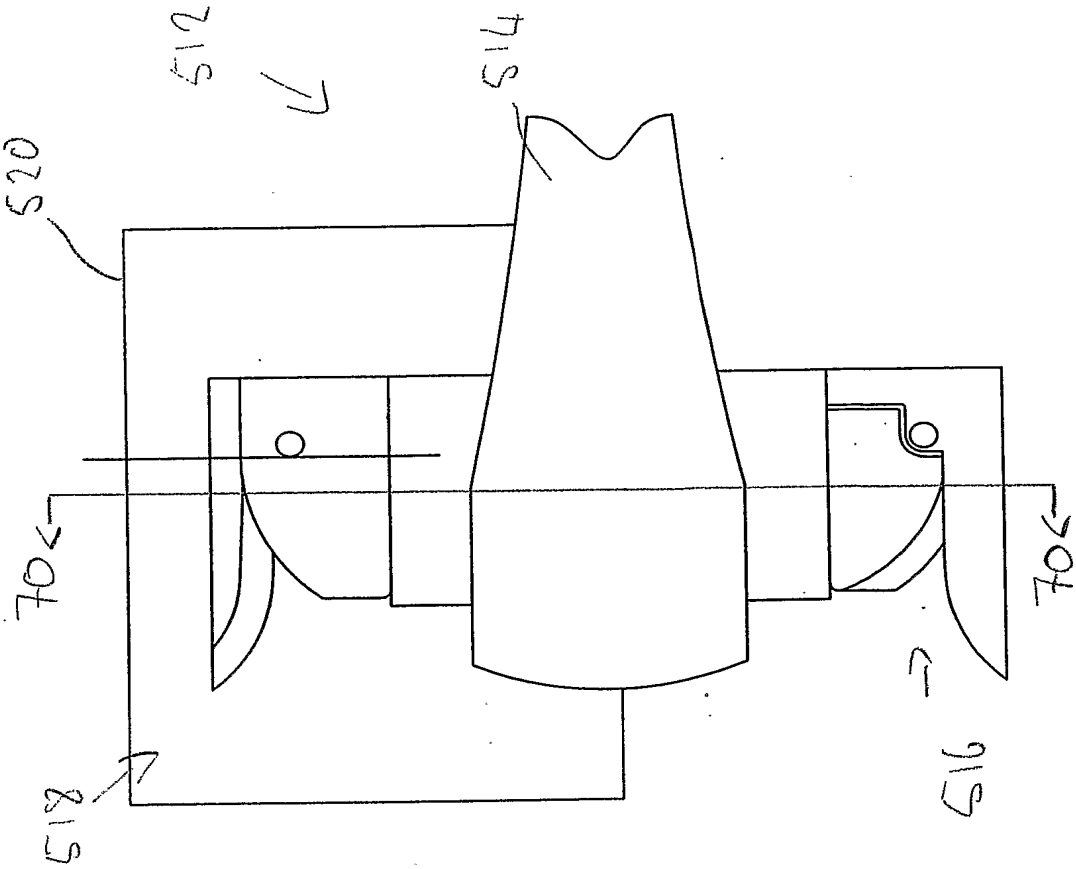


Fig 69

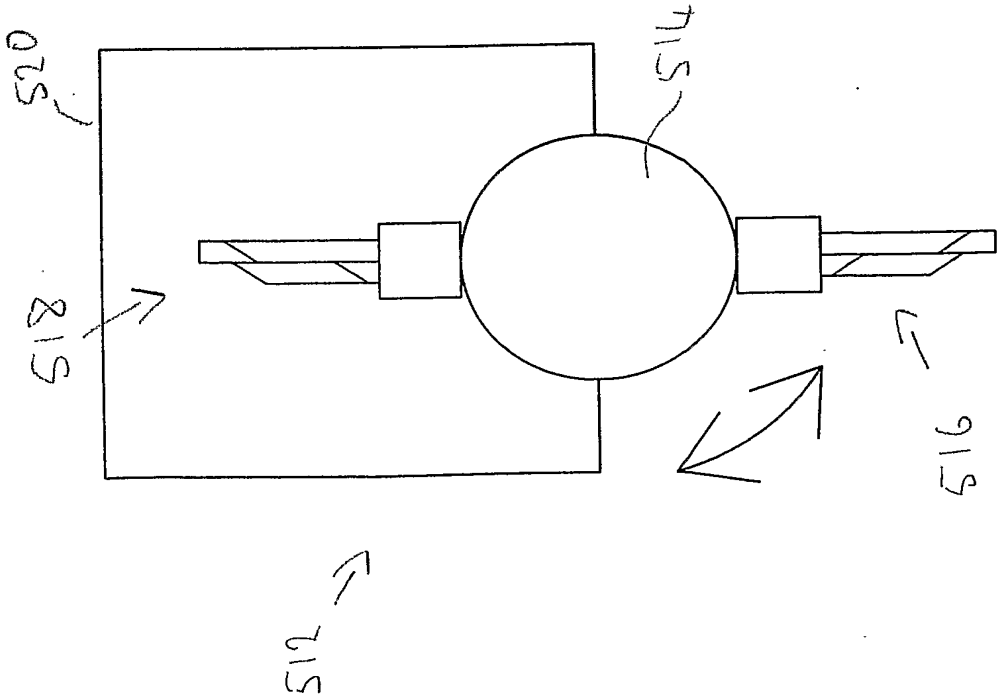


Fig 70

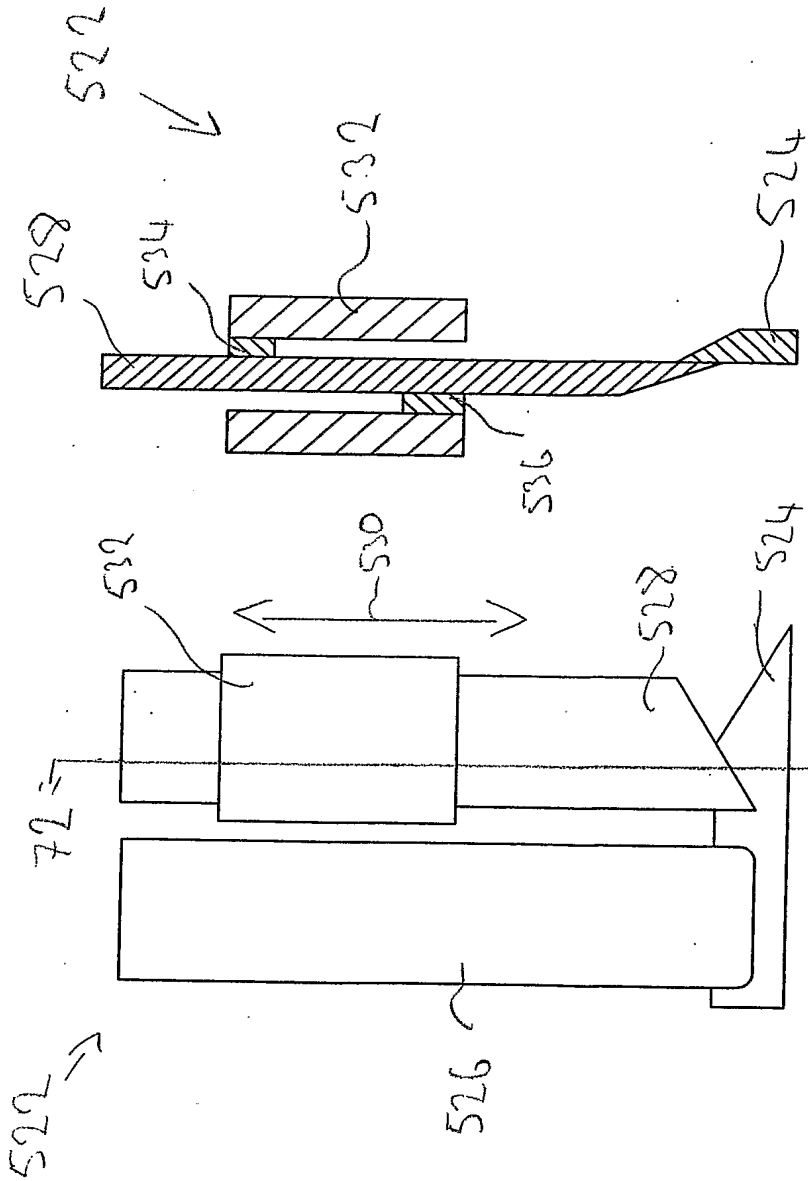


Fig 71

Fig 72

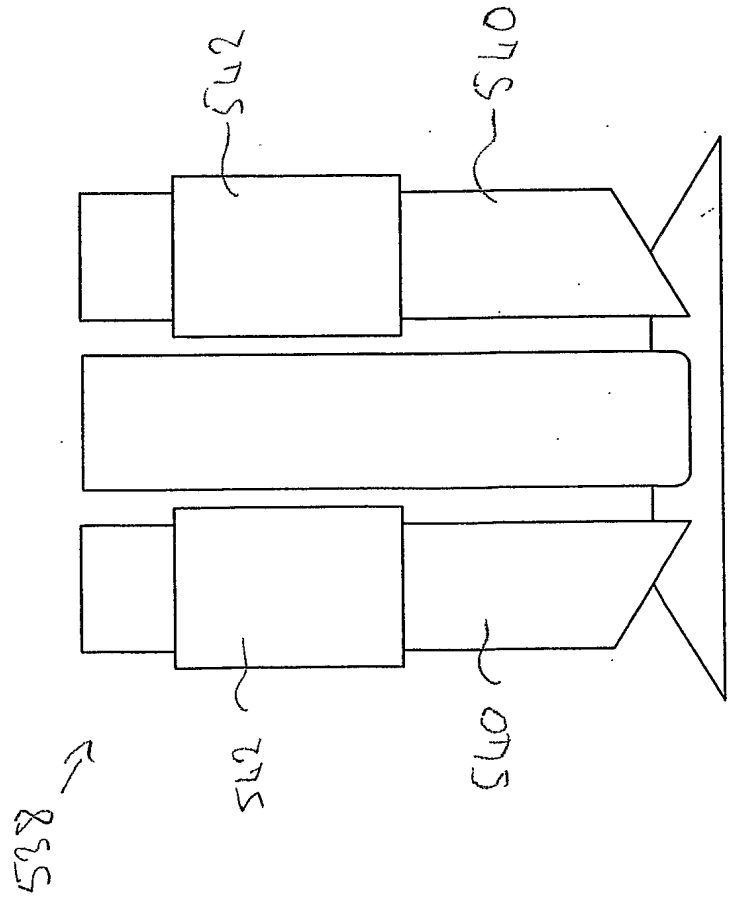


Fig 73

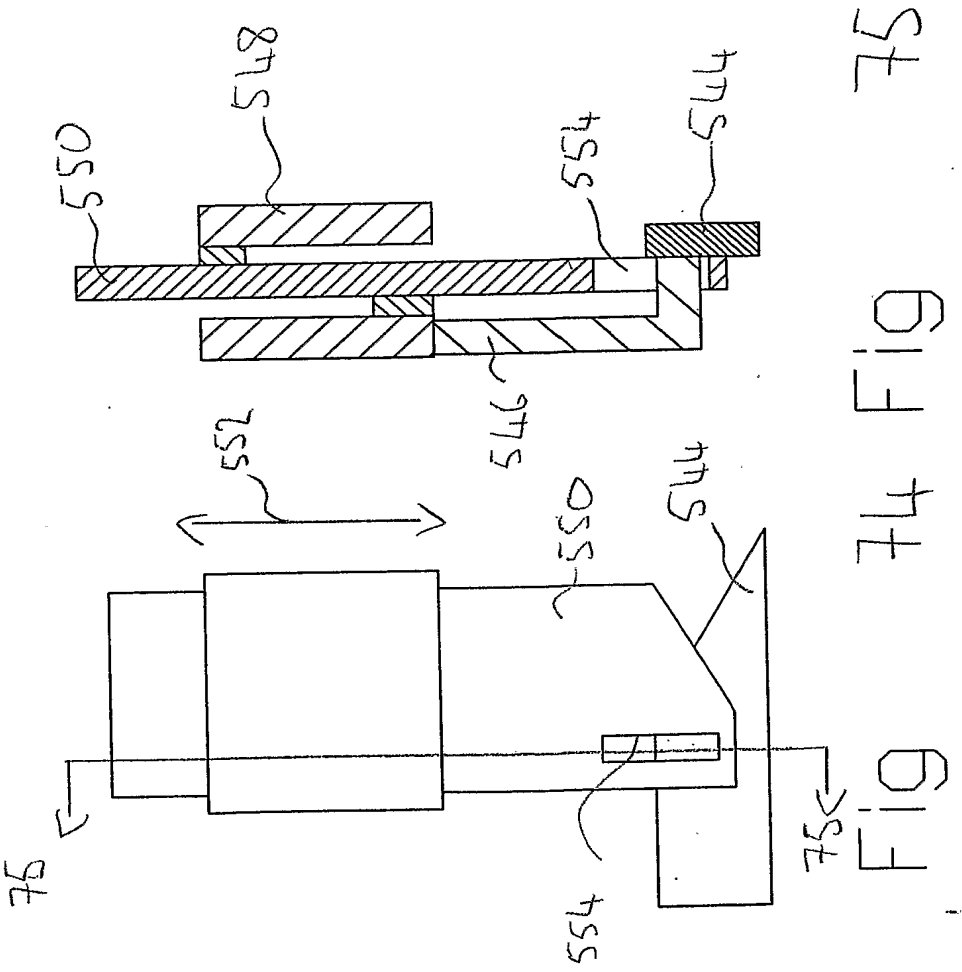


Fig 74

Fig 75

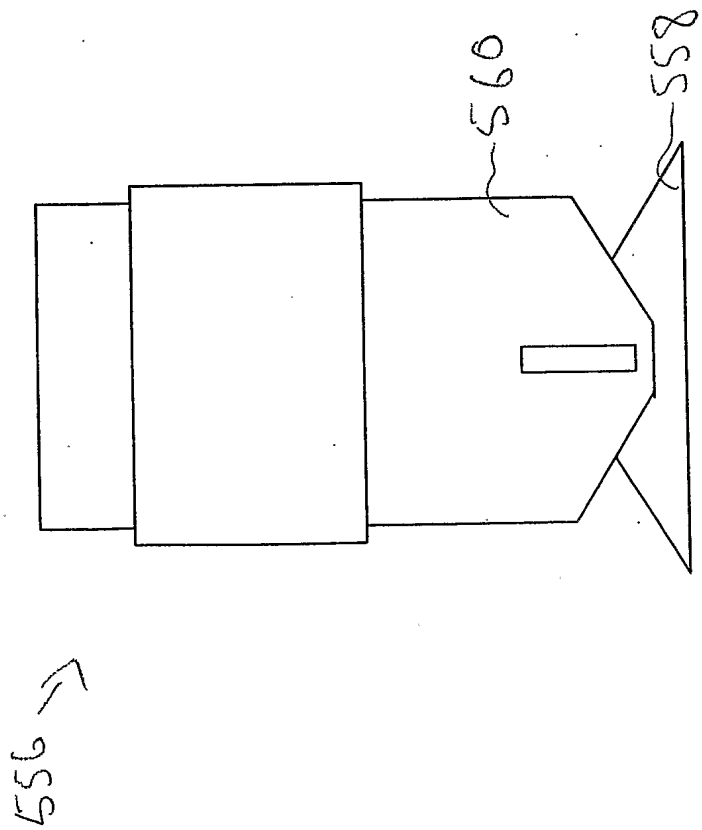


Fig 9A